CONCRETE HOUSES

HOW THEY WERE BUILT

Concrete Houses

How They Were Built

Articles Descriptive of Various Types of Concrete Houses, and the Details of Their Construction, Compiled from CONCRETE in Response to a Demand Greater Than Could Be Met with Copies of House Building Numbers of that Magazine. :: ::

Edited by
HARVEY WHIPPLE
Editor of CONCRETE

The First Edition of this Book, published in 1917, was edited by HARVEY WHIPPLE and the late C. D. GILBERT, at that time associate editor of CONCRETE. MR. GILBERT was an enthusiastic advocate of better houses, was himself a builder of them, and his work has contributed a great deal of value to the present volume.

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Preface

THIS book is published as an aid to the realization of more nearly fireproof and permanent construction of dwelling houses in America, where the waste from fire and the deterioration of slimsy construction is nothing less than a national crime by which the public suffers in pocket and in comfort.

The contents of the book are reprinted with revisions from the pages of the magazine CONCRETE (to a considerable extent from the annual House Building Numbers each January, for which the demand has always far exceeded the supply), which, while devoted to the solution of problems of concrete construction of every nature, has given special attention to the ways and means of the utilization of concrete for better houses, as a public need so fundamental and of such general advantage as to be a subject of superior importance.

When this volume urges concrete—it means *good concrete.* The general public, thinking of concrete as the material used to make safe and permanent such works as the Panama Canal, gigantic dams, great bridges and aqueducts, the highways which are to withstand the severest traffic, big ocean-going ships, sewers, wharves, reservoirs, and industrial buildings—the general public does not always realize that concrete is the most permanent structural material we know anything about only *when it is well made.* The quality of the material in any given work is determined *at that work,* in the choice of the materials of which the concrete is made, and in the manipulation of those materials in mixing, placing and hardening.

Concrete is a composite, a manufactured stone. Its particles of aggregate (crushed stone or gravel and sand—or, in some cases, slag or cinders of good quality) are held together by a binding material composed of portland cement and water. The cement and water form a paste.

Professor A. N. Talbot has used the simile very effectively and an excellent discussion of his on this subject is here quoted in part:

1. The cement and the mixing water may be considered together to form a paste; this paste becomes the glue which holds the particles of aggregate (gravel, crushed stone, slag, cinders of good quality or crushed hard-burned brick.—Editor.) together.

2. The volume of the paste is approximately equal to the sum of the volume of the particles of the cement and the volume of the mixing water.

3. The strength given by this paste is dependent upon its concentration—the more dilute the paste, the lower its strength; the less dilute, the greater its strength (providing there is the necessary minimum of water to hydrate the cement and cause it to harden.—Editor).

4. The paste coats or covers the particles of aggregate partially or wholly and also goes to fill the voids of the aggregate partially or wholly. Full coating of the surface and complete filling of the voids are not usually obtained.

5. The coating or layer of paste over the particles forms the lubricating material which makes the mass workable; that is, makes it mobile and easily placed to fill a space compactly.

6. The requisite mobility or plasticity is obtained only when there is sufficient paste to give a thickness of film or layer of paste over the surface of the particles of aggregate, and between the particles sufficient to lubricate these particles.

7. Increase in mobility may be obtained by increasing the thickness of the layer of paste; this may be accomplished either by adding water (resulting in a weaker paste), or by adding cement up to a certain point (resulting in a stronger paste).

8. Factors contributing to the strength of concrete are then, the amount of cement, the amount of mixing water, the amount of voids in the combination of fine and coarse aggregate, and the area of surface of the aggregate.

9. For a given kind of aggregate the strength of the concrete is largely dependent upon the strength of the cement paste used in the mix, which forms the gluing material between the particles of aggregate.

10. For the same amount of cement and same voids in the aggregate, that aggregate (or combination of fine and coarse aggregates) will give the higher strength which has the smaller total area of surface of particles, since it will require the less amount of paste to produce the requisite mobility and this amount of paste will be secured with a smaller quantity of water; this paste being less dilute, will therefore be stronger.

11. For the same amount of cement and the same surface of aggregate, that aggregate will give the higher strength which has the less voids, since additional pore space will require a larger quantity of paste and therefore more dilute paste.

12. Any element which carries with it a dilution of the cement paste may in general be expected to weaken the concrete—smaller amounts of cement, the use of additional mixing water, to secure increased mobility in the mass, increased surface of aggregate, and increased voids in the aggregate all operate to lower the strength of the product.

13. In varying the gradation of aggregate a point will be reached, however, when the advantages in the reduction of surface of particles is offset by increased difficulty in securing a mobile mass, the voids are greatly increased, the mix is not workable, and less strength is developed in the concrete. For a given aggregate and a given amount of cement, a decrease in the amount of mixing water below that necessary to produce sufficient paste to occupy most of the voids and provide the lubricating layer will give a mix deficient in mobility and lower in strength.

A certain degree of mobility is necessary in order to place concrete in the forms in a compact and solid mass, the degree varying considerably with the nature of the work, and generally it will be found necessary to sacrifice strength to secure the requisite mobility. It is readily seen, however, that the effort should be made to produce as strong a cementing layer of paste as practicable by selecting the proper mixture of aggregate and by regulating the amount of mixing water.

More thorough mixing not only mixes the paste and better coats the particles, but it makes the mass mobile with a smaller percentage of mixing water, and this less dilute paste results in higher strength. Any improvement in method of mixing which increases the mobility of the mass will permit the use of less dilute paste and thereby secure increased strength.

It may be added that for a small increase in the amount of mixing water the difference in the strength of the concrete after considerable time has elapsed appears to be relatively less than it is at the earlier ages, provided, of course, sufficient moisture is at hand to permit full chemical action to be maintained.

Good concrete of a standard cement and clean, hard, well-graded aggregate, combined in proper proportions with cement and water, and thoroughly mixed to make a homogeneous, quaky "mud" (the vernacular of the construction job); well consolidated in the forms and properly hardened—such a material will make good houses.

HARVEY WHIPPLE.

Concrete Houses[1]

By Harvey Whipple and C. D. Gilbert

Drawings By Glenn M. Rees
Architect, Rochester, N. Y.

Every home builder benefits by the accumulated experience of others, as expressed through his architect and his builder. Equally he is the loser by that experience which holds to traditional methods and materials long after better things are obtainable. This conservatism, coupled with a mental laziness that resists the effort required to develop new ideas, is chiefly responsible for the slow development of the fireproof house.

The percentage of houses in which concrete is the principal structural material has been so small that the man who builds a fireproof house is looked upon in most localities as a curiosity and his work as a kind of dementia.

Those best able to advocate the better dwellings and to make them successful—the architects and the builders, as a class—have been so wedded to traditional materials that their opposition can generally be counted on to discourage the layman who has the foresight and the temerity to believe that a better house should be secured for the money he is about to spend under presumably expert direction.

This condition is deplorable from the standpoint of loss to individuals and to the community, by the persistence of burnable houses, with their attendant evils of constant painting, repairs and depreciation.

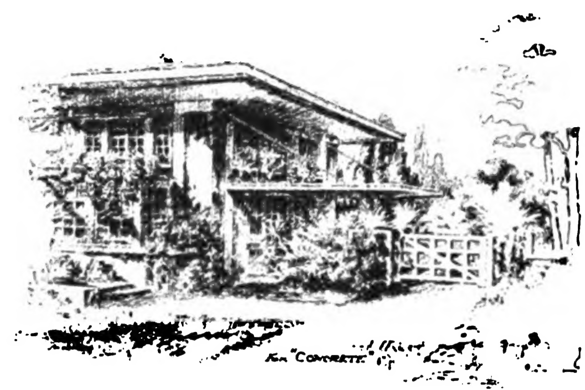
It is regrettable, too, because not a few concrete houses have been the work of men whose zeal and appreciation of concrete have not been coupled with an equal appreciation that care in construction must be combined with architectural training, so that full advantage may be taken of the inherent excellence of the *plastic stone.* Their lack of experience too often resulted in dwellings whose raw crudeness showed concrete at its worst. Its inherent beauty was lost. Thus has come about the perpetration of numerous monstrosities calculated to substantiate the statements of those who prefer to work with other materials.

Concrete Design—Not a Masquerade

It is the outstanding fault of numerous houses of concrete that they are both uneconomical and unconvincing, from an architectural standpoint, because they are frame houses or brick houses masquerading in another, radically different material.

When concrete is to be used, the designer should think in terms of concrete, from footing to parapet, and the ideas of our traditional tinder boxes and all their component factors should be cast to the winds. Do architects and builders as a class never feel the need of new fields to conquer?

It is true that concrete houses of conventional plan and elevation can be built, but always at an undue expense. It is equally true that in the treatment of the elevation there is great opportunity to take advantage of the plastic and fire-resisting qualities of the material economically by departing from the house architecture familiar in America.



It is not necessary that the architect create such designs in their entirety—he has for his inspiration the wonderful work of the finest Italian periods, he has the architecture of the Orient, and he may gain suggestions from the work of primitive peoples. Our own best colonial work is not without inspiration to the designers of concrete dwellings.

While most house builders will prefer a compromise, utilizing concrete where its advantages are most obvious and other materials where convention or personal taste dictates, there is much to be said for the use of concrete as the major material throughout the house, with only enough of other materials to add the needful decorative touch. Such full use makes for economy, since it permits fuller employment of mechanical helps and less dependence on numerous trades. An investigation of the individual problems of concrete house construction discloses certain outstanding facts that apply to individual parts of the structure.

Footings and Basement

Concrete is obviously the best material for foundations. Water-proofing should be used for basement walls and floors where drainage conditions require. Insulation and dampproofing considerations make desirable an air-spaced wall by the use of hollow blocks, double walls or furring. Building codes are notoriously deficient in their provisions, often requiring concrete house walls of excessive thickness and not providing for insulation by air-spacing.

In the modern house basement, space is too valuable to waste, and provision should be made for laundry, shop, amusement rooms, and so on, in accordance with the occupants' requirements. Comparatively small expense will add desirable rooms that may be dry, well lighted and attractive. The heating plant should be separated by solid walls from the rest of the basement, and the coal storage preferably provided under a porch. This will confine most of the dust, especially if ashes can be removed without going through other parts of

[1]Concrete, January, 1918.

the basement. When the partitions are also the bearing walls that are the most economical support for floors, the expense of division is little, if anything, extra.

House Walls

Much latitude is possible in wall construction, which may be of the unit or the monolithic type. The bogy of dampness with concrete walls is dispelled when given intelligent thought and honest work. In dry climates, without extreme ranges of temperature, solid walls of reasonable thickness are probably satisfactory, but in general the excellent qualities of concrete should not be called upon unreasonably to give immunity from the enforcement of natural laws. Solid walls may be water and damp-proofed. Even this depends too much on the personal element to be dependable as a general rule.

CONCRETE WALLS AND TIE ARCHES BUILT IN 10TH. CENTURY

Temperature and atmospheric conditions take little account of workmanship, and the solid wall will be a conductor of heat, and cold walls will condense moisture from saturated air, regardless of their structural material.

The necessary insulation is provided by air spaces within the wall or may be secured by the application of furring and lath to solid walls.

Wall construction divides sharply into unit and monolithic classes. Of the first the common hollow block is the best known and has through its use by unskilled builders done much to discredit the use of concrete units. As distinguished from the muddy textured rock face "block," the modern concrete "stone," well proportioned, skillfully made and "set," combines the beauty of natural stone with the economy of a manufactured product.

Insulation is most effective when the unit is so designed as to leave the protecting air space as free from concrete as possible. Indeed, a type that gives two entirely separate walls, bound by metal ties, is used satisfactorily where furring and lath are omitted. Some progress has been made in the use of large precast units, in general cast hollow, but their use is practicable only in the construction of groups of houses, where erection facilities are at hand. In such work their great possibilities have barely been touched.

The present tendency is toward building house walls of rough concrete units of ample strength, but with no suggestion of finish, presenting rough faces as an ideal surface to receive plaster and stucco finishes. This method has the great advantage of low cost units made on a large scale, to be erected as desired and to receive a variety of finishes already made popular in spite of the abuse of the stucco house idea with work done on unsuitable plaster bases.

Monolithic walls can be so cast that on removal of forms a finished surface, or a surface that *can be finished* without stucco, is produced. Very beautiful results have been obtained in this way. A rustic effect may be desired, or form marks may be acceptable as honestly expressing the material used, or special care may be taken in making the forms, or special facing mixtures may be used, or the surface may be brushed, tooled, bush hammered or rubbed—by taking a discriminating advantage of any one of numerous ideas for the surface to be obtained, the builder has a latitude for his taste and for his purse which few, if any other, materials make possible.

Unless, however, the preference is for a bold and somewhat rustic effect, the special form work or special facing mixtures or subsequent treatment on a wall whose surface is monolithic with the structure, will cost no less than for a rough wall finished smooth or rough with any one of several popular stucco treatments.

The difficulty of producing thin, double, monolithic walls by placing the concrete in deep forms, is very great, and has led to the introduction of double wall machines, the work of which may be compared to the laying of rough wall units, since the machine travels along the wall building double or triple reinforced walls. The simplicity and flexibility of the equipment is noteworthy and the results, in competent hands, are of unquestioned quality, presenting a perfect plaster base, to which stucco can be applied economically. Unit, steel, pan-like forms are used with success by some builders to construct solid walls, while the use of lumber for forms is still quite general, chiefly, perhaps, for the reason that our builders are mostly graduate carpenters, or carpenters at heart, or yet, in fact, in whom the use of boards is a tradition not to be discarded lightly.

Floors

The value of fireproof structural floors for residences is coming to be recognized, and they are now being used in many of the better homes, even where concrete is not used for walls.

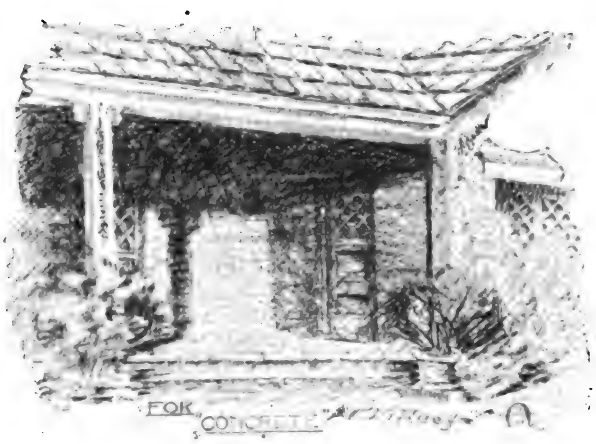
The expense is not prohibitive, if the owner is willing to consider the use of the concrete floor without an expensive surface flooring. The man who builds a house without too rigid economy may choose terrazzo, tile, cork carpet, etc., but for the less expensive house a well finished concrete floor can safely be recommended as highly desirable, in spite of popular prejudice against it. The criticism that such floors are cold is not founded in fact, where modern heating systems are used. The addition of furnishings removes the bare look associated with concrete, as seen in basements and factories.

Indeed, the floor in its natural condition is not found objectionable by some, but it is susceptible to treatment with paint or with stain, varnish and wax, to meet practical and decorative requirements. Neutral textures—a lack of high polish—are readily attained in concrete, and they enlarge the apparent area of small rooms and

display to better advantage the rugs, furniture and decorations, while the sanitary qualities of the concrete floor are unsurpassed.

The advent of the vacuum cleaner has apparently turned the thought of decorators back to all-over carpets, in which there is exhibited a renewed interest. Concrete floors with tacking strips, would provide an ideal base for carpets.

Structurally, the concrete floor is simple and economical. The flat slab with one or two-way steel is probably desirable in some cases, because of its simplicity and



because it permits flat ceilings without further treatment. A more economical floor can often be built by the use of steel pans or wood forms, giving a ribbed floor that requires less material. This construction is desirable for the first floor, and for situations requiring a suspended ceiling, and could well be used throughout in very low cost houses, where the beams could be left exposed. With carefully studied combinations of beams and slabs, this construction could be adapted to the principal rooms of large houses. For isolated houses, where the unlikelihood of its reuse would not warrant form investment and where flat ceilings are desirable, the tile and joist floor is probably the most practical solution because of the small lumber waste and the small amount of skilled labor required in the construction.

The Roof

It is the roof that gives the designer of concrete houses at once the most trouble and the greatest opportunity. The characteristics of concrete are not easily adapted to a domestic architecture whose thought for 300 years has been of wood. The steep pitched roof is adapted to easy construction in wood; it is picturesque and has unquestioned architectural charm. As before intimated, the architect has new worlds to conquer. It becomes a matter for the owner to decide and for his

architect to create. Is the home builder to have permanence and fire protection, together with economy and possibilities for new usefulness that the flat roof offers, or must he forego these because his architect is unresourceful?

The inherent qualities of a material and the economic necessities incident to its use are at the beginning of the architect's problem. He cannot ignore them; he should not misuse them. He should find inspiration in availing himself of structural qualities and economic necessities and molding and shaping them to serve an aesthetic as well as a practical purpose.

He is not without precedent. He does not stand alone. He may take courage among the flat roofs of old Salem and Newberryport; he may be cheered at Mount Vernon and spurred to his task by the missions of California.

The design of small, moderate sized flat-roof dwellings involves a study of proportion and an adaptation of carefully considered detail, but the difficulty should be accepted as a worthy challenge. The problem requires skill for an attractive solution. Much can be done with wide cornices and suitable treatment of parapet walls and with windows and entrances. Some home builders who appreciate fireproof construction will undoubtedly still prefer the pitched roof, and if covered with fire resistive material a very safe construction can be secured, particularly if there is the protection of a concrete attic floor. Concrete roof tile are probably the least expensive roof covering of pronounced architectural value—with color and texture—and they combine well with stucco walls.

The true concrete roof will be approximately flat. It may be pitched slightly to the outside, but common sense again reverses the conventional method of disposing of roof water and pitches the house roof inward to one or more sumps, as in industrial buildings. The advantages are obvious, as gutters and downspouts are always expensive and are prolific sources of trouble. Disposing of water through a center conductor reduces trouble possibilities to a minimum. The warmth of the house serves to keep the sump open at all times.

A statement that no roofing material is needed on a properly constructed concrete roof slab, will be considered radical, yet such roofs of an area that would cover the average man's house have long been in successful use. Means are at hand for providing joints where needed. If properly constructed there is little danger of leakage, and even should temperature stresses eventually cause cracks, repairs are easier than on most roofs. A few inches of sand or earth covering would almost certainly prevent trouble from cracking of prop-

erly reinforced roof slabs. Where land is limited, such roofs open wonderful possibilities for roof gardens and playgrounds.

Trim

There are satisfactory metal window frames, sash and metal doors, but their cost will prevent their extended use in house construction. Desiring fireproofness, most of us will still refuse to give up the beauty of wood trim. Window frames may be of the familiar box type, and economy of wood at no increased cost is secured by the use of spring balances for double hung windows, while casement sash require a minimum of frame.

Inside of the house much can be done to eliminate combustible material. Individual taste may demand paneling or extensive window and door trim, and in matters of one's personal taste there should be no argument. It is well to consider, however, if as desirable effects cannot be obtained in other ways. For instance, in most houses, much material and time are used to put more or less elaborate trim around window and door openings, trim which always must be cleaned and refinished; yet when window hangings are in place the wood wall trim is scarcely seen. An inexpensive hollow metal trim is now to be had that is applied before the plastering is done and finishes the plaster against the frame in a neat and substantial way. Some will find such trim around openings restful by comparison with the over-trimmed and molded openings so much used.

Where concrete floors are used the concrete is turned

up with a cove at the floor angle and meets the wall plaster either flush on a metal screed or with a slight projection.

Decoration

In combination with stucco, the decorative possibilities of the exterior are unlimited and stucco houses everywhere built offer suggestions. It should be remembered as a first principle that concrete and plaster are unexcelled as backgrounds for the works of nature. The designer of a concrete house should never lose sight of this fact, and should take full advantage of it. The plainest house, if reasonably well proportioned, can in a few years be transformed by trees, shrubs, vines and flowers. If, in addition, judicious use is made of a few brick and tile for warmth of color, and a few boxes of evergreens for contrast with walls, the effect is then perennial.

How Will the Individual Builder Get a Concrete House?[1]

And What Kind?

By Harvey Whipple
Editor Concrete

WHEN there are so many hundreds of thousands of people who want houses to live in, it will be a good thing for the concrete industry to take stock of what it has to offer—find out what part it may hope to play in satisfying a demand that will reach somewhere near the peak in the next building season.

There are plenty of reasons why concrete houses should be built: First, on the general principle that we here in America should be better housed.

In these times when conservation has come to be the watchword of our kitchens, our coal bins and our clothes closets, we should live in houses that do not represent so big an item of national waste. This waste is figured up in long columns of items for fire losses, decayed lumber, paint, and other maintenance and repair necessities, for excessive fuel—in general, for too high an annual cost over a term of years for places in which to live and be comfortable.

Then again concrete houses should be built because more local materials may thus be utilized.

But most emphatic and most telling of all is the fact that more concrete houses *will* be built because there is a shortage of materials out of which to build

—because concrete construction requires a smaller percentage of skilled labor

—because—and this selling argument should not be overlooked—the permanent house is cheaper now than it ever was before when compared with the cost of other kinds of houses

—because the man of moderate means cannot afford to invest the amount of money that building construction costs him in a structure that will levy a heavy tax on him for upkeep before he has paid off the mortgage.

A rich man can afford to live in a tinder box, perhaps; but a poor man must buy goods that will wear well.

Now, all these things being so, and the time being ripe, what will the concrete industry be able to do about it? How does the land lie? What means are available to turn sand and gravel and crushed stone and cinders and cement into houses?

So then, if a man in Newark, or Nashville, Charlotte, or Oshkosh, Kalamazoo, or Owatonna, Austin, or Helena, sees the light; decides that he can't afford to build a rattle-trap house—that he has got to build to stay; that he must save on fire insurance and preserve his peace of mind and save money on fuel and fixings from year to year; if he decides that he wants permanence so far as may be in this world, and comfort, and doesn't want to spend a mint of money on the first cost of his enterprise—in short, if there is a man in any one of these places, or in any other place, who is effectually sold in his own mind on the concrete house and ready to talk business—then to whom is he going to talk business and what is to be done? And what is a concrete house, anyway?

Of course, house fires are more or less every-day matters. People consider themselves lucky if they escape disaster and their houses don't burn down.

This year the demands are for houses to live in, and we can expect no sweeping change of public conscience which would put the avoidance of disastrous fires out of the "luck" category.

Yet any time a man reaches that plane of thought in which a safe home is of as much consequence as a Ford runabout, a man may make it safe for about that much additional outlay and with what he saves in insurance and upkeep by having that kind of house, he will be in better shape to maintain the runabout.

Good houses, as such things are generally understood, may be built of monolithic concrete or of concrete block or other precast units, and the use of either type of construction for the walls gives solid support for floors of the right kind for safety.

Who Will Build a Concrete House?

IF the man wanting a house goes to the average carpenter builder and explains his wants he may be discouraged. In the first place, the average carpenter builder doesn't know why or how a house should be built of concrete, and he will be prejudiced against its use. That's natural.

If you want to be discouraged in any enterprise, go to a man who doesn't know how. Nine times out of ten he'll say it can't be done.

But let's see what there is to offer the citizen who wants a concrete house.

What Systems and Methods Are Available?

FROM year to year in its house-building numbers, and in other issues, Concrete has described the methods employed and the results obtained in various systems of monolithic house construction and in the application of various precast units, large and small, to the erection of homes.

Among the more pretentious housing enterprises with concrete are:

The monolithic houses at Gary, Indiana, with the unit forms now known as Metaforms.

Two hundred houses at Morgan Park, Minn., for the Minnesota Steel Co., with Hydro-stone block

Much more extensive work with the same type of

[1] Concrete, January, 1920.

units, but with far more pretention to architectural effects at Halifax

A hundred monolithic houses at Donora, Pa., built with Lambie steel forms through part of the contract and finished with wood forms.

About seventy one-story cottages built at Manhattan Beach, more recently, using the same steel forms

Group dwellings for the General Chemical Co. at Claymont, Del., using Morrill steel forms for the greater part of the work.

Earlier work on double houses with the same steel forms at Nanticoke, Pa.

A ten-house group built by the Simpsoncraft system of precast slabs and cast-in-place frame work, at Lansford, Pa.

Several hundred dwellings in France built by the Harms-Small system of monolithic walls and precast floor units.

The large group of terrace dwellings at Youngstown, built by the Unit Construction Co., employing large precast units.

The earlier and more architecturally pretentious work along similar lines, but with the precast units manufactured with finished surfaces for outside and inside—the work of Grosvenor Atterbury, at Forest Hills, N. Y.

A twenty-five house group whose monolithic walls were put up in record time by the Van Guilder double wall system at Youngstown, for the Carnegie Steel Co.

A row of two-story monolithic houses at Cleveland by the Hydraulic Steelcraft system.

The monolithic houses at Phillippsburg, Pa., built by the Phillippsburg Development Corporation with Ingersoll forms, and a smaller group built by the same system at Union, N. J.

These are outstanding jobs among the many that have been considered, most of them in considerable detail, in the pages of CONCRETE.

All of them have been successful operations in some degree, some of them to a marked degree. Some were carried through under adverse conditions, which did not give the system employed a fair chance to demonstrate its full value.

Now let's group these systems by distinguishing characteristics, somehow to arrive by elimination at what may now at this precise time be made available for the uses of the individual builder, who may or may not be trained in the use of any one of them.

Large Precast Units

CONSIDERED in the large, the Atterbury and Unit Construction Co. systems are the same—both employ very large precast floor and wall units, requiring big cranes and derricks to place them. The Atterbury system involves shop finishing of surfaces with special facing mixtures; the Unit system does not. The Atterbury system is admittedly still under development by the Standardized Housing Corporation. The Unit system, according to the engineer in charge of work at Youngstown, is not suited to developments of less than 100 dwellings in a single operation.

Both these systems appear to offer great promise of giving real service under skilled direction for large undertakings where considerable outlay for initial plant is justified.

Monolithic Construction

THE Lambie steel forms are in heavy sections—just too heavy for one man to handle, making the labor charge somewhat greater, we are informed, than for wood forms. Under certain advantageous labor conditions, they may undoubtedly be used on individual house jobs with satisfaction when they may be rented or when used frequently by a contractor who has already invested in the necessary equipment and is familiar with its use.

The Hydraulic forms, while apparently giving most satisfactory results on the group of Cleveland houses, are at present undergoing further development to meet the approval of their producers.

The Harms houses in Europe, built under the direction of Henry J. Harms, represent the only use of the system of which we are informed. The form units are heavy, of cast iron—to give true joints—and are probably not adapted to individual house building, because of the tremendous weight of equipment to be transported.

The Lambie and Hydraulic forms provide for pouring a story height at a time. The Harms forms are set up for the entire job, the precast floor units being set as the forms go up.

In this general class of operation comes the Ingersoll system. Data obtainable from the work at Union and Phillippsburg warrant the statement that the results fully justify the expectation of C. H. Ingersoll, who originally had them built to solve housing problems among his own watch factory operatives. The forms are of wood and the sections are heavy, yet with a trained crew the erection operations proceed rapidly and a complete cycle of operations (from a footing and basement floor, which is the support for the forms) through complete erection of forms, pouring and stripping, ready for erection for the next house, has been made with twelve men in less than six days—giving a six-room-and-bath concrete shell, fully piped and conduited, with walls, floors and roof in one piece, surfaces unfinished. Admittedly, however, this system is not adapted to an operation involving less than forty to fifty identical houses.

Combined Precast and Cast in Place

THE Simpsoncraft system looks complicated in a set of house details, but not so complicated on the job. It employs thin precast slabs for walls and floors, with precast concrete beams, erected; temporarily supported and joined—tied into a monolith, so to speak—by the reinforced studs which are cast in place. A house is carefully detailed in advance and all the unit panels predetermined to standardize them as completely as possible. The pre-casting operations are simple, the necessary plant equipment small and the success of the work depends upon having a skilled carpenter and a skilled concrete foreman, both of them well grounded in the details of the system. Only under exceptional conditions, with the best skilled direction, would the work be adapted economically to small operations.

Other Monolithic Work

OF the systems employed in the housing enterprises listed there remain for consideration the small, light-weight unit steel forms—Morrill and Metaform; double wall machines—notably Van Guilder—and then concrete block, the only type specifically mentioned in the large housing undertakings listed, being Hydrostone.

The original Reichert forms, in their present development known as Metaforms, were used on a number of individual house jobs with success, particularly in the vicinity of Milwaukee, and the same type of form on the big job at Gary.

The Morrill forms have been used successfully on

group enterprises and on individual jobs, a number of which have been described in detail in CONCRETE. Mr. Morrill has developed the use of his small steel units to employ them clamped together to be handled in tiers for twenty-inch or two-foot elevation at each tier. Thus a comparatively modest equipment suffices for single-house construction. The Morrill equipment is not at this time in the hands of many builders. Much of the work done with it has been in some degree supervised by Mr. Morrill.

WOOD FORMS

SO much for the commercially available systems of forms.

Before passing to a consideration of the double-wall machine, it must not be lost sight of that individual contractors have used wooden forms, frequently made up for use in horizontal panels, and thus with two sets of panels successively raised one above the other in pouring house walls, much after the method employed with the Morrill forms, in tiers. Many satisfactory individual house-building jobs have been carried on in this way. The success of such work may be measured by the skill of the individual builder, his knowledge of the material concrete, his familiarity with the short cuts and economies in handling it and placing and finishing it.

The Van Guilder double wall machines have been in increasingly successful use for a number of years. Year by year new men have been trained in the use of the equipment to get the best results, for the least cost—and facility in handling is the main item. One crew of four to five men may easily do twice as much work as another crew not so well trained. Such a difference runs into a considerable item of labor cost, even on a small job. There are about a hundred of these wall machines in use throughout the country. They are no longer for sale; the Van Guilder company now is operating as a parent company in the development of contracting organizations in various centers of population.

The machine is simply a double mold, without bottom or ends. After the footings are ready, angle irons are set up at corners to maintain perpendiculars. The machine is set on the footing and the two sides filled and tamped with concrete of such a consistency as to permit the immediate release of the mold, which is shoved along ready for filling in another section of wall. Each operation makes a tier nine inches high and about five feet long in two walls each 4 inches thick, separated by a two and one-half inch air space, the two walls are tied together by galvanized wire hooks at short intervals in each course. When a complete circuit is made the machine is set up on the first tier and another circuit is made. It is possible under usual building conditions to put in four tiers a day, thus raising a wall three feet. The machine works directly up to window and door frames. Exterior surfaces are stuccoed and walls plastered inside directly on the concrete—this being made possible by the continuous air space.

BLOCK WALLS

THE Hydro-stone block is in two types (see details, page 34); one for the so-called one-piece block wall, having projecting interior lugs, virtually forming concrete studs, to which furring and lath are fastened, and the two-piece wall, in which two opposing two-lugged block, inside and outside, form a continuous hollow chamber.

The Hydro-stone block are distinctive in the fact that their development has been with a feeling for architectural uses and special care has been given, in the few plants where the block have been made, to produce units of attractive appearance for finished wall surfaces. The exposed face of the block is 9" x 24", which departs from the usual sizes in the more commonly known block types.

The prospective builder, deciding to use concrete block may find that there is no Hydro-stone block in his territory—in fact, it is being made in very few places. That type of block is singled out for special attention here because of its use in two of the large housing projects listed at the beginning of this survey of what is available, and because Hydro-stone has undoubtedly had a higher architectural development than any other standard block type. Many of the manufacturers of the more common block types have been satisfied with foundation work. Yet there is good reason to believe that this condition is about to be corrected. Block manufacturers are organizing in many localities to develop the uses of their products and improve their quality. The builder will be able to discover who are making good block in his territory and will be able to influence to a considerable extent the architectural character of that block, (somewhat as outlined in another article in this book on the subject of "Surfaces"). Block manufacturers will make what is demanded. There are many types of block to be used with entire satisfaction in residence work when the block are made somewhere near as well as they can be made.

In this, structural tile must not be overlooked. There is an increasing appreciation of its special qualities. It is made on several different machines now on the market, and in some few places has already undergone a very remarkable development. It differs from the ordinary concrete block, as hollow clay tile differs from brick. It is thin walled, and when well made gives a strong, light building unit which lays up rapidly and gives much truer surfaces than burned clay products. It is particularly suitable for use with a covering of stucco.

The problem of the individual builder who wants a concrete house simmers down in this summary of what is available to a few basic considerations.

First, what will his local building laws, if there are any, permit him to build?

The Hydro-stone block, with its relatively thin outer wall and projecting lugs forming studs, is a type unrecognized in most building codes, although probably it would never be rejected for residence purposes after a careful examination of what kind of wall it makes possible.

Again, the Van Guilder system supports its floors on the inner four-inch wall—and a four-inch wall is a heresy in building codes. Yet the system has withstood such tests for rigidity and crushing strength, entirely beyond the requirements of residence construction, as to make its eventual acceptance certain.

In the single monolithic walls many building codes offer difficulties. Concrete is frequently placed on a basis with brick and must be in 9" or even 12" thicknesses, where 6" and 8" of good concrete would give a very large factor of safety from every standpoint.

Similar conditions restrict the use of the common types of concrete block in many places, so that their use has been confined to a great extent to foundations.

The conditions cannot persist. Sufficient demand will change them.

Good walls can be and are built with all of these four general types of construction just named.

The double walls need not be furred on the inside for

lath and plaster. Single walls should be furred in all dwellings in the northern half of the United States. It must be borne in mind that a concrete block with a hollow space in the center *does not* make a double wall. The solid spaces remain, which raise the necessity for furring.

There are shown eight pages of details of wall and floor construction of concrete.

These are followed by articles descriptive of numerous examples of the use of concrete by various methods.

The matter of surface finish is considered in a separate article.

So much is available for the individual builder.

He has but to find the contractor who knows concrete.

Or else—why not?—the contractor must find *him*.

Concrete for Attractive and Permanent Dwellings

THE FIRST FOUR PAGES SHOW EIGHT VIEWS OF A MONOLITHIC WALLED CONCRETE HOUSE

Marsh House

Near Darien, Connecticut, the Home of

F. RAYMOND HOLLAND

HUNTINGTON BOSWORTH, N. Y. C., ARCHITECT

MARSH HOUSE, NEAR DARIEN, CONNECTICUT

THE LIVING ROOM AND AN EXTERIOR VIEW OF THE STUDIO, MARSH HOUSE

ENCLOSED TERRACE, WITH INTERESTING CORNER ARCH—LOOKING OUT OVER LONG ISLAND SOUND

THE ROUNDED CORNERS—THE SOFT PLASTERED EFFECTS OF ITALY ARE SHOWN IN THIS ENTRANCE DETAIL

THE PLEASING SIMPLICITY OF ARCHED OPENINGS IS WELL SHOWN IN THIS ENTRANCE DETAIL

BELOW ARE VIEWS OF MAIN ENTRANCE HALL, SHOWING THE SIMPLY BUILT DOORS, AND OF A WALL FOUNTAIN, WITH A GLIMPSE OF EVERGREENS AGAINST THE GRAY STUCCO

A CONCRETE HOUSE, AND DETAILS — TYPICAL OF THE RESIDENCE WORK OF IRVING J. GILL, ARCHITECT, SAN DIEGO, CAL.

Mr. Gill has shown that concrete in broad masses can be beautiful; he makes full use of grouped windows and arches. With the advantage of picturesque settings and lavish plant growth, he assigns to nature a definite part in the decoration of his work.

Residence of Alfred E. Patterson, William H. Kuni, Archt., Detroit, Mich. This house, with the charming roof lines of the English cottage, has walls of concrete tile. They are covered with a rough-cast stucco of light color.

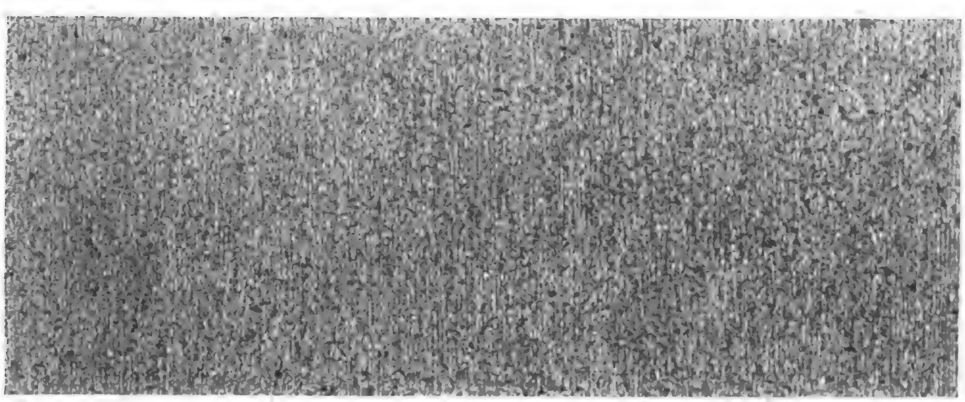
Residence of William E. Schulzke, Architect, Moline, Illinois. Stucco on Metal Lath

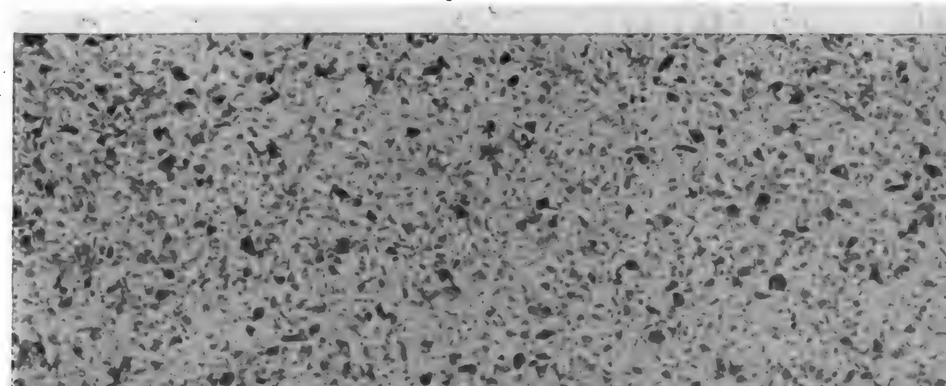
Ten Plates Illustrating
Concrete Surfaces

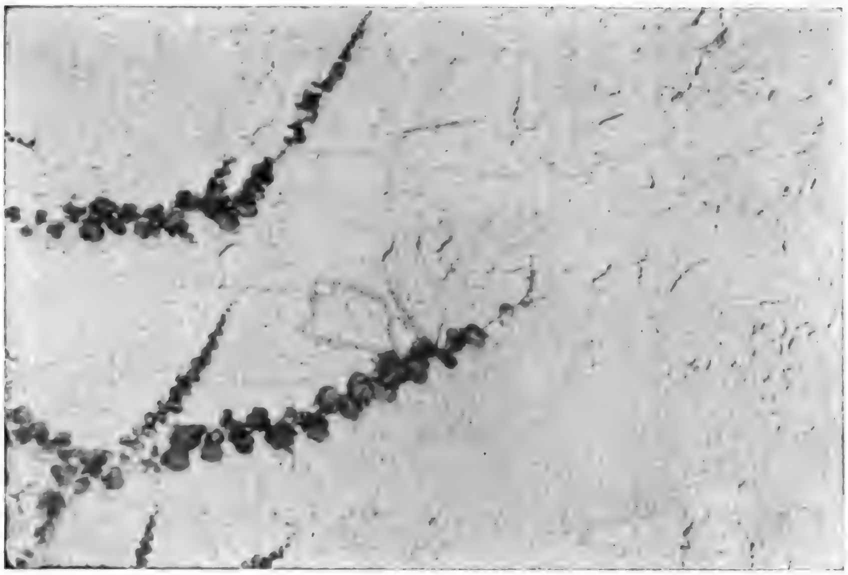
(Top) Two Grades of Facing Mix—Employing Fine and Coarser Crushed Stone — Surface Brushed While Green — Very Inexpensive and Avoids That Pasty Smoothness of the Common Fine Sand Facing — Courtesy of R. H. Bushnell, Poughkeepsie, N. Y.

(Center) Fine Tooled Surface of Concrete Stone Cast in Sand Molds—Courtesy Emerson & Norris Co., Boston

(Bottom) Brushed (While Green) and Acid Washed Surface with Facing Mix of Mica Spar Crystals — Courtesy The Hydro-Stone Products Co., Chicago





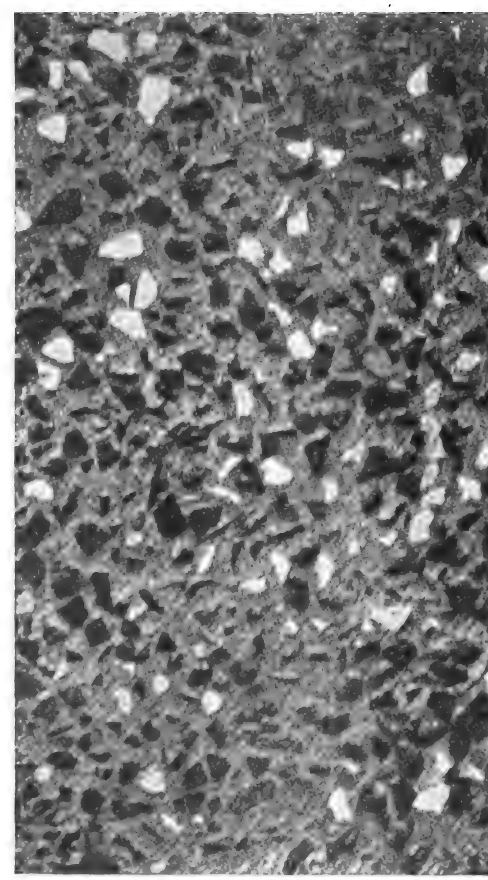


(Top to Bottom) 1—Thin Coat White Stucco on Monolithic Wall Never "Gone Over" a Second Time, on Concrete House in Virginia — Courtesy Milton Dana Morrill, Architect, New York City

2—Dry Dash Stucco—For Beautiful Tones with Colored Aggregates—Courtesy Atlas Portland Cement Co., New York City

3—Parallel Tooling in Concrete Stone—Courtesy Emerson & Norris Co., New York City

(At Left) Detail of Mausoleum of Concrete Stone—Rubbed Surface—Courtesy Joseph Eilbacher, Elizabeth, N. J.



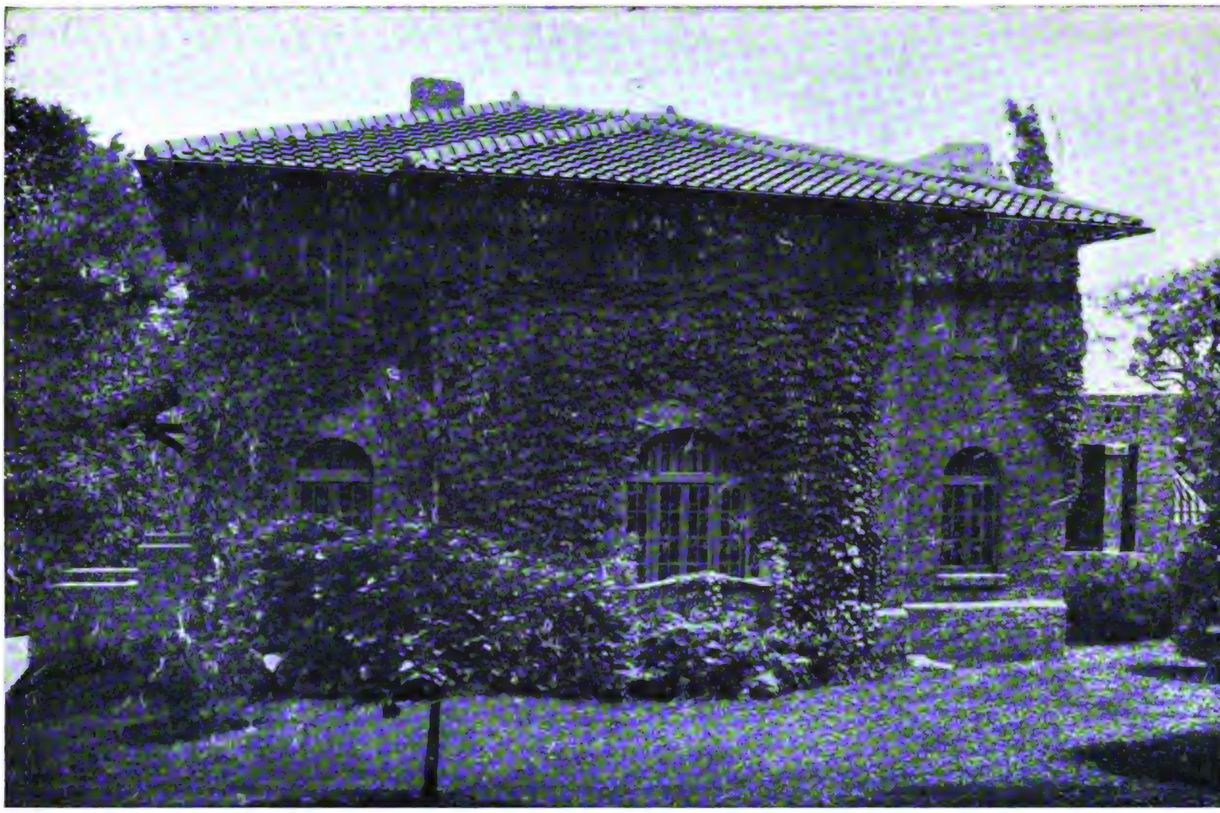
(At Right) Brushed Out Facing of 1 Part ¾" White Marble Chips, 4 Parts ¾" Green Marble Chips, 2½ Parts Sand, 1 Part Cement—Courtesy Vulcanite Portland Cement Co., New York City

(Below) Brushed Out Surface of Selected Mix of Crushed Potomac River Pebbles.—Courtesy John J. Earley, Washington, D. C.

A Washington Park Building, Showing Something of the General Effect, without a Full Idea of Color Value, of the Concrete Surface.
The Work of John J. Earley

Cottage of Concrete Block, Cobblestone and Kellastone Stucco — Built and Occupied by Carl Mess, Phillips, Wis.

Spacious Bungalow at Mooseheart, Illinois — Built of Hydro-stone Block, for Loyal Order of Moose, Under the Direction of R. F. Havlik



EIGHT YEARS OF NATURE'S WORK ON CONCRETE HOUSE AT SOUTH ORANGE, N. J.

Three illustrations are shown of the home of Albert Moyer, at 324 Ridgewood road, South Orange, N. J. It was built in 1907 and is a most interesting example of the way in which a concrete house, when carefully built, fits into a landscape and comes in time to furnish a beautiful background for the draperies of nature.

The walls are of solid concrete and are not faced, as might be supposed, but are of like quality of concrete throughout. The aggregate was carefully selected to give a certain effect in the finished work, and instead of having a plaster or a stucco surface the concrete was scrubbed and cleaned to expose the aggregate immediately after the removal of the forms. This concrete was composed of 1 part cement, 3 parts limestone and white marble, the size of sand, and 1 part ¾″ trap rock, giving a good color variety. There is a great deal of exterior decoration which, however, is unobtrusive, as the colors of the tile inserts are primitive, pastel shades in low tones. All the tiles were hand-made and were burned in a primitive manner. The lines of the house are very simple, almost severe, yet this severity of line is fully compensated for by the richness of the entire concrete surface, and now, after the lapse of a number of years it is further enriched by the shrubbery and the vines.

The house is 42′ wide, not including the loggia, and 55′ deep. The windows are casement made with English leaded glass. The roof is of Japanese pan tile, run of kiln, and some of the tiles are smoky red, others salmon, and all the various shades are mixed together, giving a most pleasing result. The architects are Tracy & Swartout, New York City.

Two Views, Concrete Residence of Albert Moyer, 8 Years After Construction

Concrete Block Houses —Hydrostone System— at Morgan Park, Duluth, Minn., for Minnesota Steel Co.

Here Variety, Economy and Stability Were All Attained

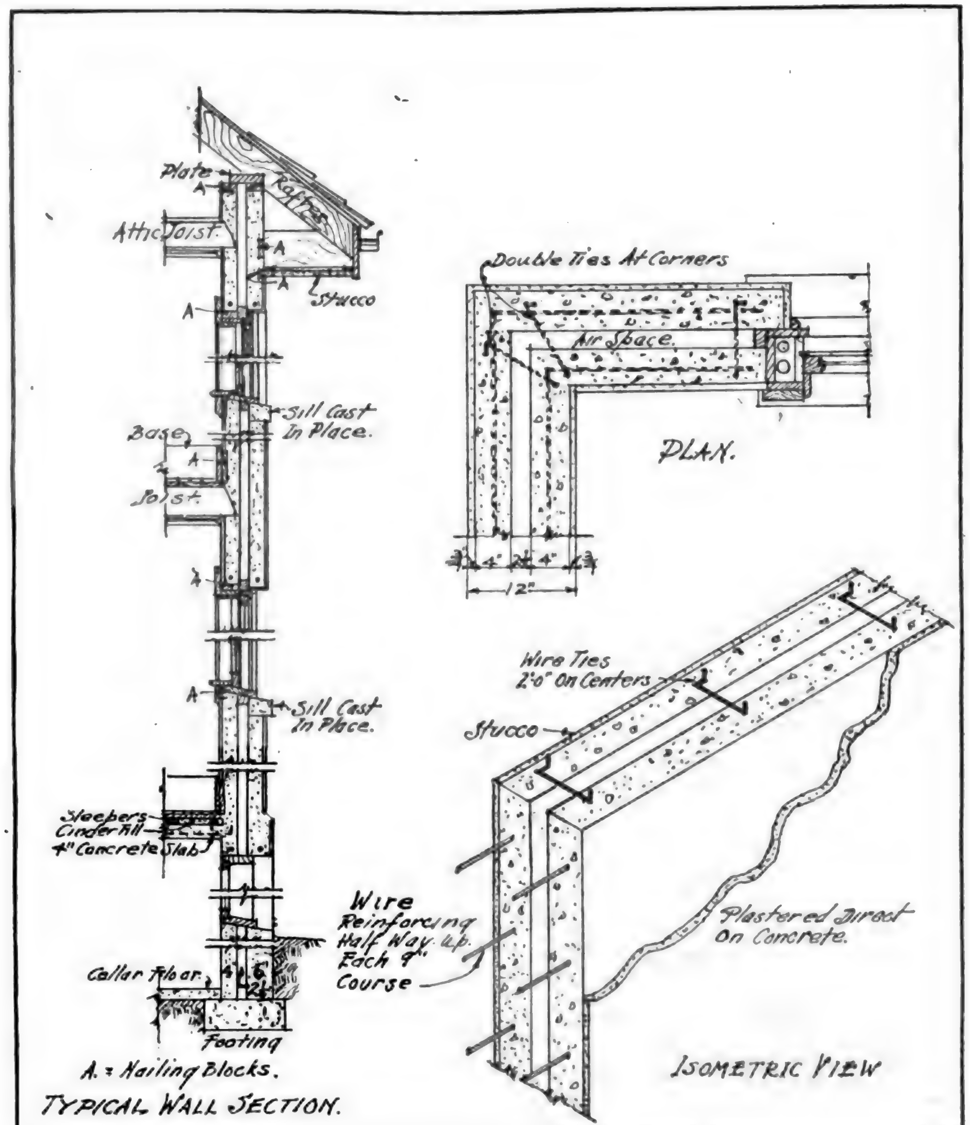
The Block Are Plain Faced, but of a Rough Interesting Texture

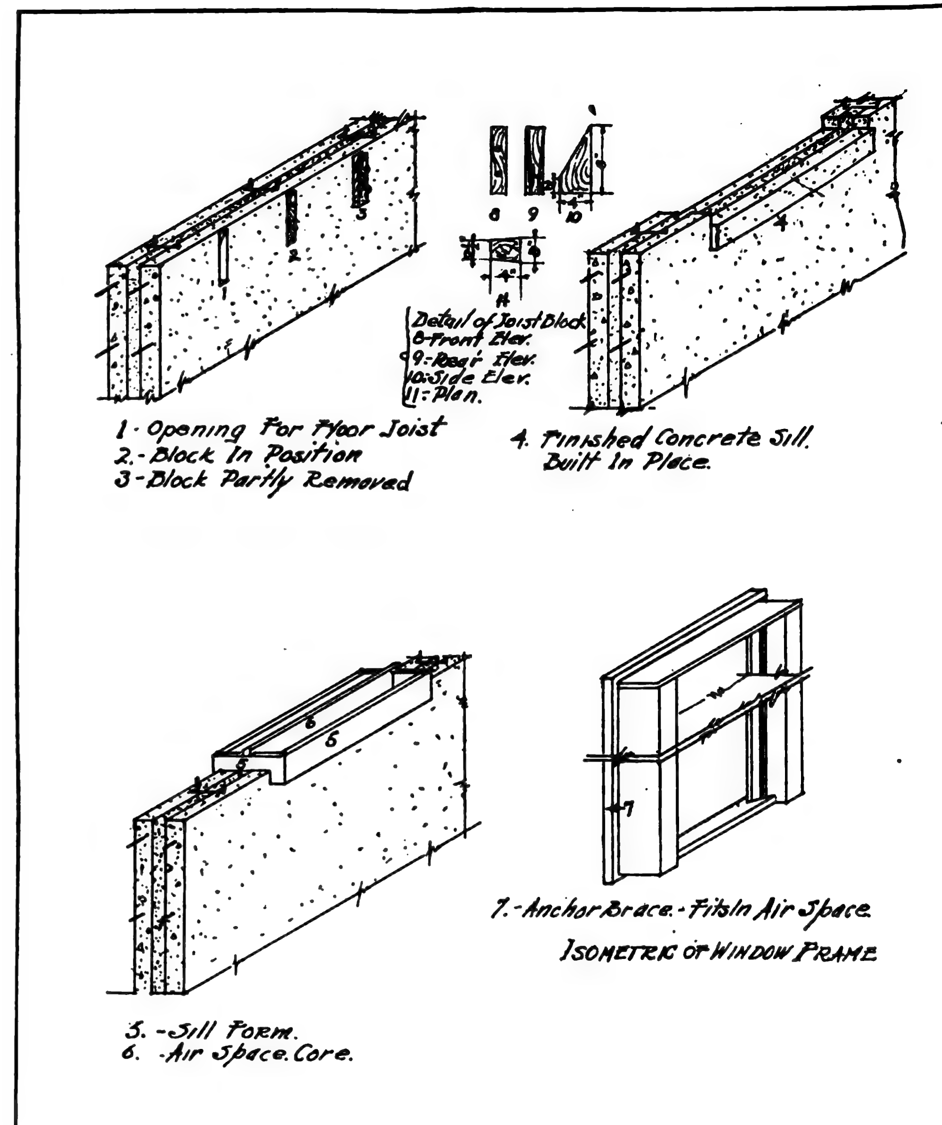
Three Views of Bungalows of Concrete Block — Stucco Covered — at Riverside, Illinois

HOME OF W. D. LYON, GLENN RIDGE, N. J.—DOUBLE WALL CONCRETE, BY THE VAN GUILDER SYSTEM.

A CONCRETE PERGOLA—COURTESY MILTON DANA MORRILL, ARCHITECT

BEFORE - AND - AFTER VIEWS OF THE RESIDENCE OF LOUIS N. STIX, CINCINNATI, RESTORED AND BEAUTIFIED WITH STUCCO





Figs. 1 and 2—Details of Double Monolithic Wall Construction with a Double Wall Machine—Courtesy Van Guilder Double Wall Co.

The detail on the left (Fig. 1) shows a typical vertical wall section, with concrete floor indicated in the first story and wood joist floor in the second story, together with a plan of wall at corner, showing how windows are taken care of and made weather tight. At the right (Fig. 2) various construction details are shown—how walls are blocked for the insertion of joists; how two-piece sills are cast and a window frame detail showing how frames fit into the hollow space in the wall.

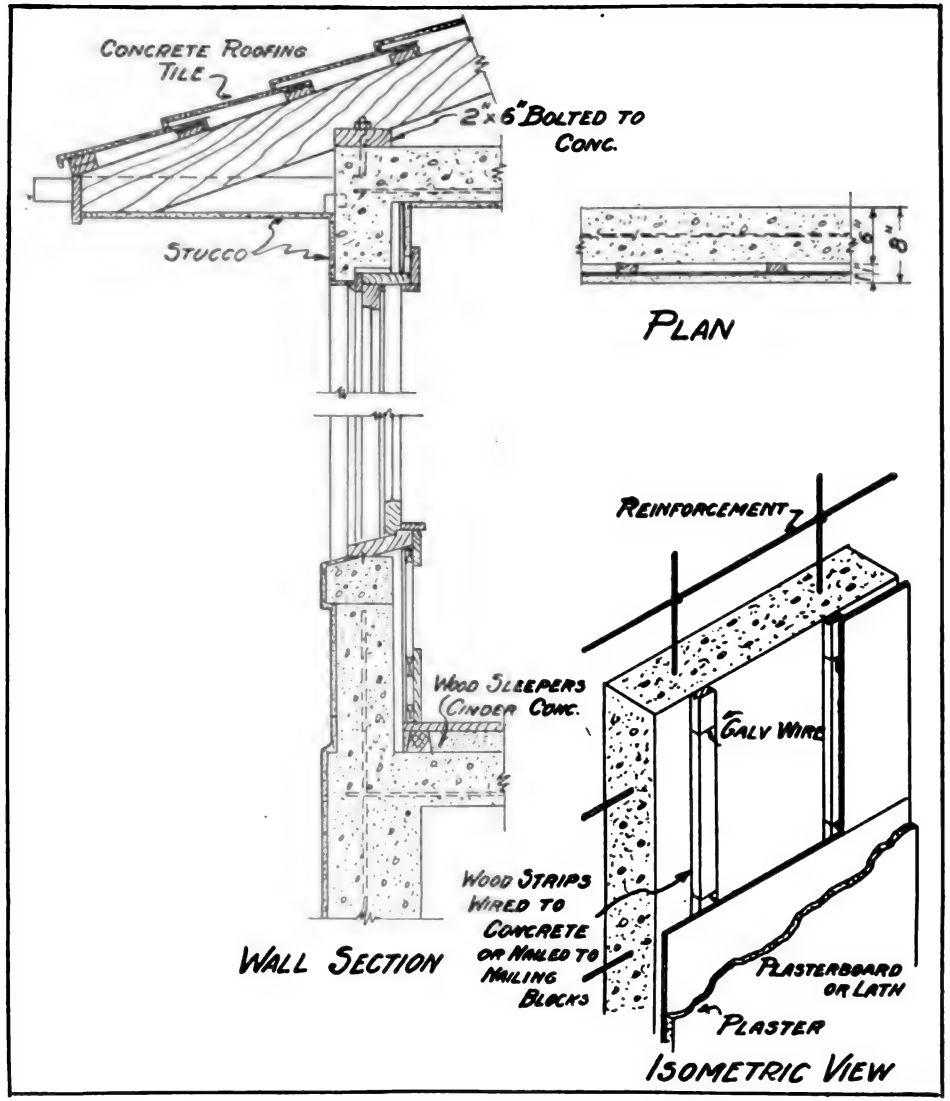


Fig. 3—Wall Section Plan and Isometric View of Monolithic Construction.

This is typical of the conventional design of monolithic houses, with various types of steel forms, and with wood forms, showing the placing of reinforcing and the very necessary furring on the interior wall so as to create an air space between the wall proper and the interior lath and plaster.

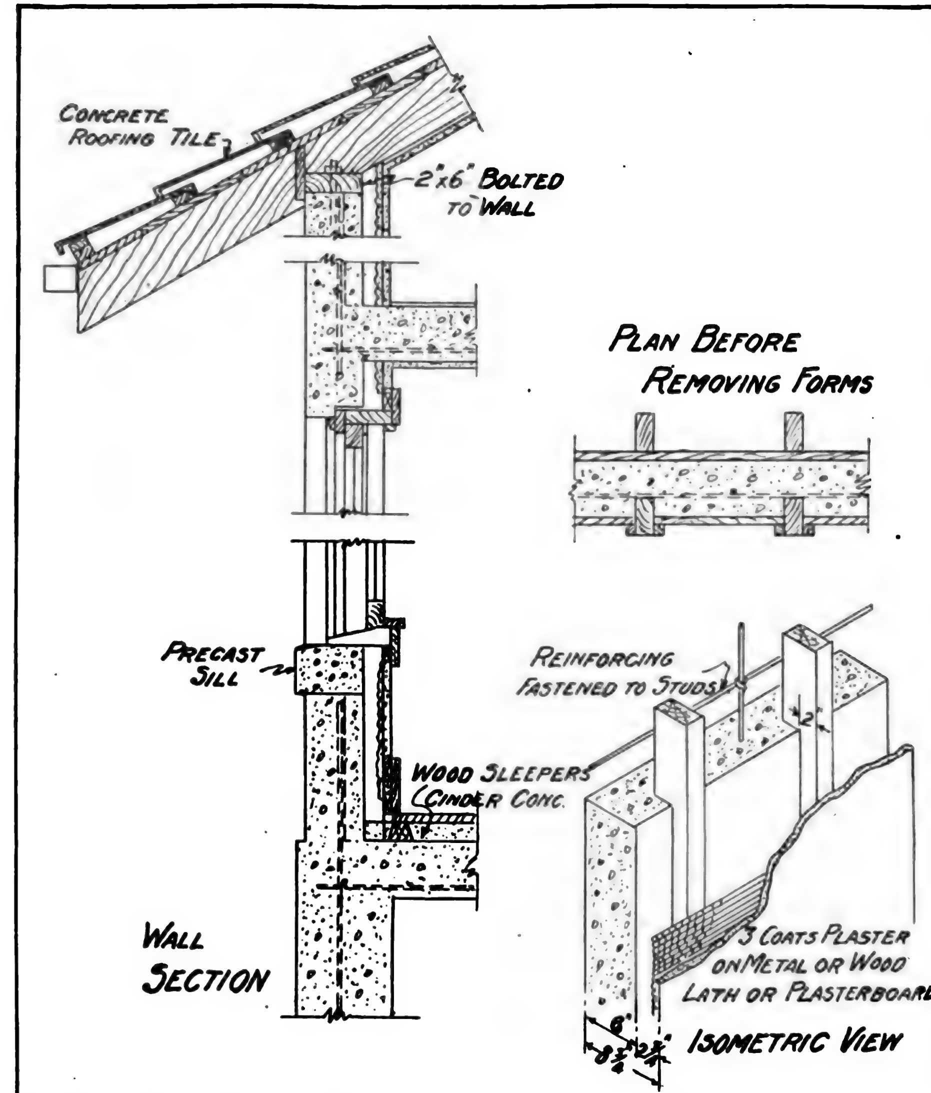


Fig. 4—Detail of Monolithic Construction with Embedded Studs—Believed to Have Been Originated by W. H. Parrish, Roslyn Farms, Near Pittsburgh

The plan, before removal of forms, shows how the studs support short form boards and leave, ultimately an air space behind the lath and plaster.

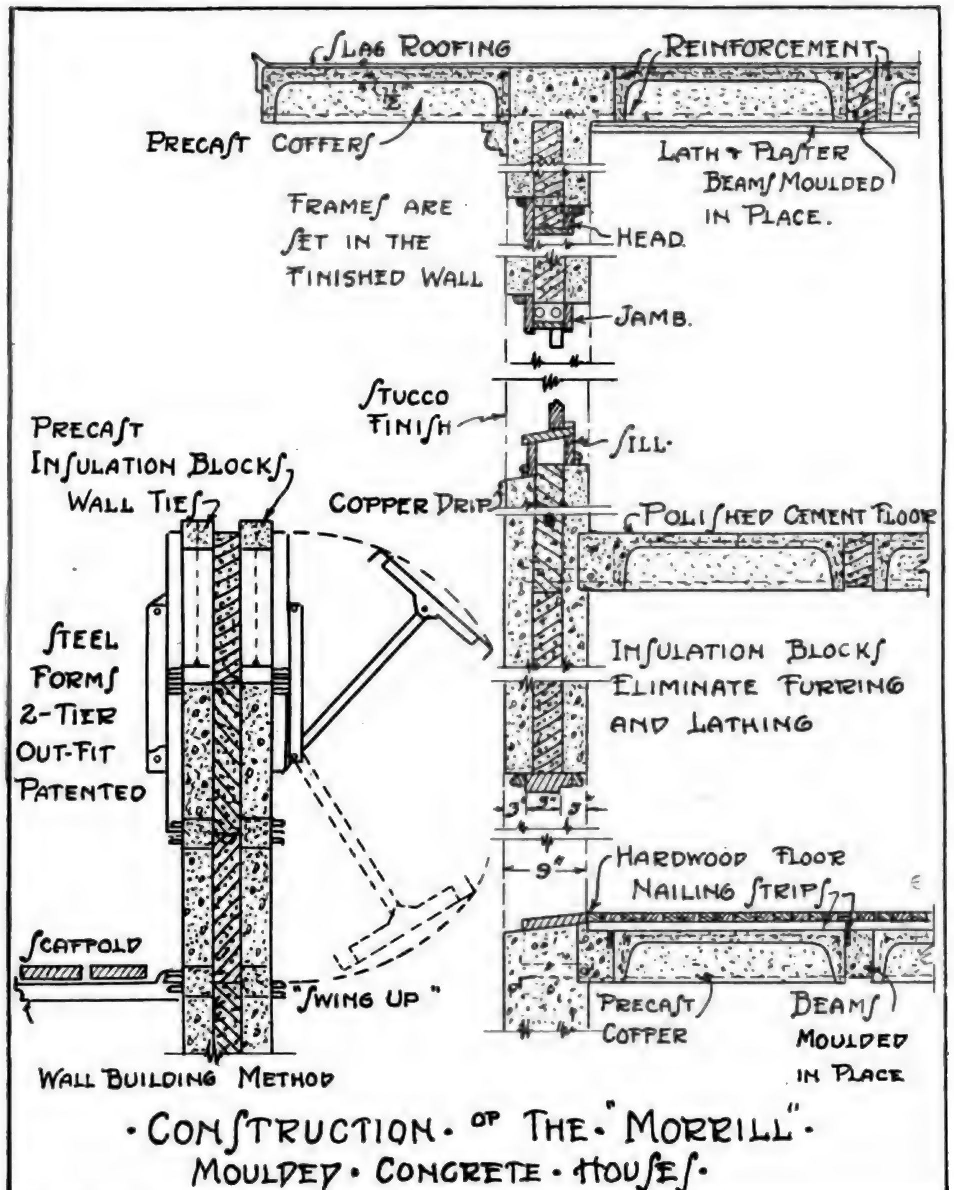


Fig. 5—Details of Suggested Construction Embodying Several New Features—Contributed by Milton Dana Morrill

While most of the work done with Morrill steel forms has followed more nearly the details presented in Fig. 3 on the previous page, this page shows a proposed improvement. At the left the detail shows how scaffolds are supported during construction on the same pipe sections (extending through wall) as are used in supporting the forms for previous courses of concrete. This further details the "swing up" method of handling the steel form sections in horizontal tiers. Neither of these features, however, is new to Morrill construction. The new idea shown here is in the use of precast block of porous cinder concrete set in the center of the wall between forms and filled in on both sides with structural concrete, the porous block providing insulation against both heat and moisture. Mr. Morrill here has in mind the same idea of wall insulation as is embodied in the construction used by Mr. Gauvin on the "cold·proof house" described elsewhere in this book—the principle being that the ideal insulation is provided by air—*still* air—and that to keep air *still* it is necessary to break it up by small cells or chambers, thus preventing convection currents which cause the air to move from the hot to the cold side of the air space. Another new idea as here suggested is in the use of precast concrete boxes, turned bottom up, for floors and held by beams running both ways between the boxes. This is on the same principle as the floor dome or pan form.

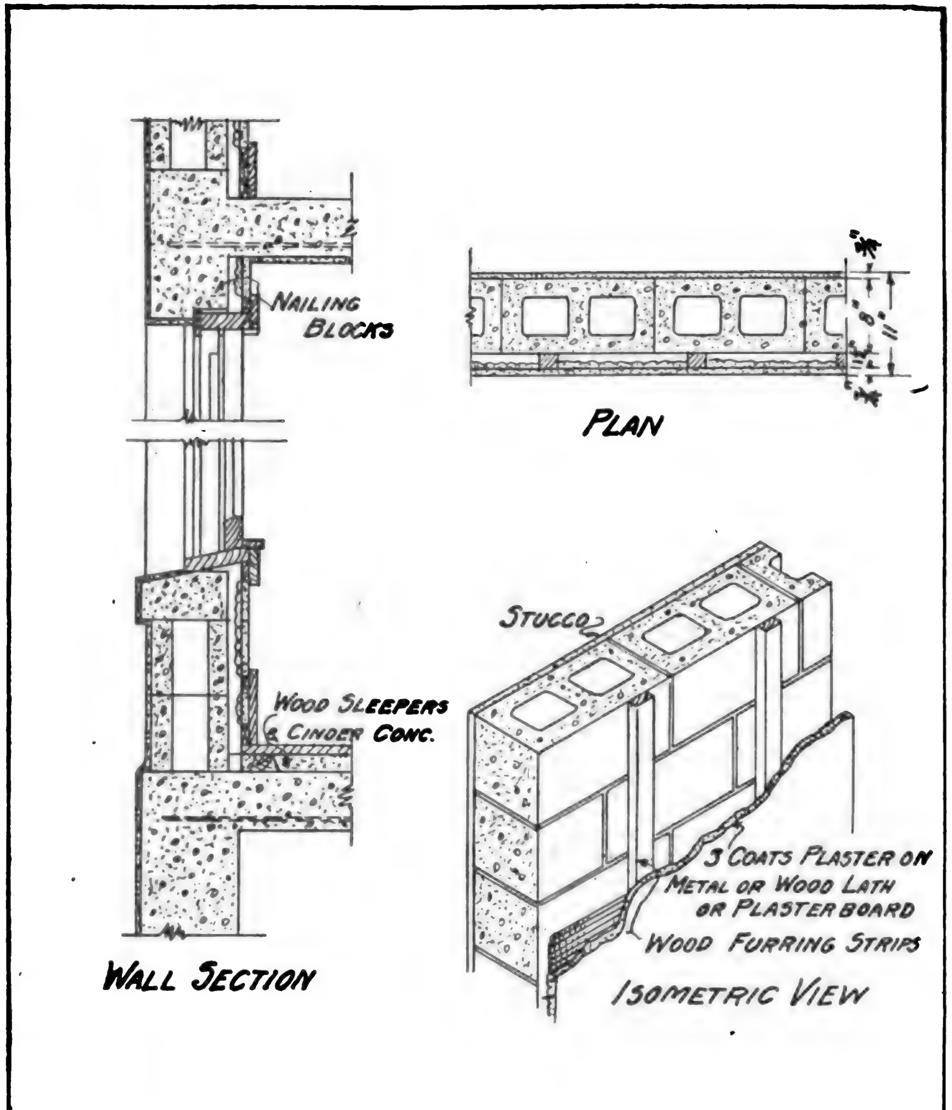


FIG. 6—DETAIL OF HOUSE CONSTRUCTION WITH FIREPROOF CONCRETE FLOORS AND HOLLOW CONCRETE BLOCK OF CONVENTIONAL TYPE

This detail shows the furring as an essential feature of the construction despite the hollow spaces in the block. On Page 36 are further illustrations showing practice in laying up concrete block of various thicknesses and types.

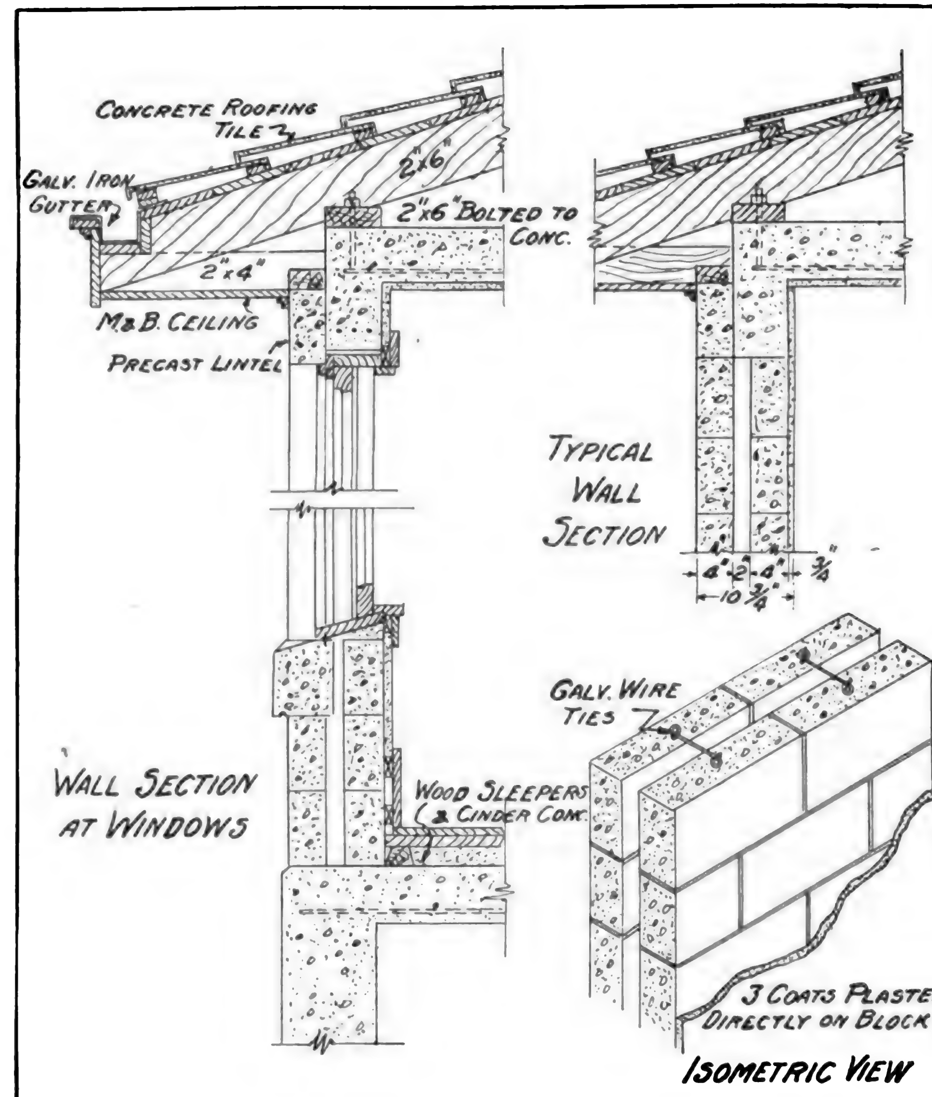


FIG. 7—DETAIL OF CONSTRUCTION WITH TWO-PIECE CONCRETE BLOCK HELD BY TIES IN THE JOINTS TO FORM A DOUBLE WALL

Such block may be made on machines of the usual type by the removal of cores and the insertion of a dividing plate.

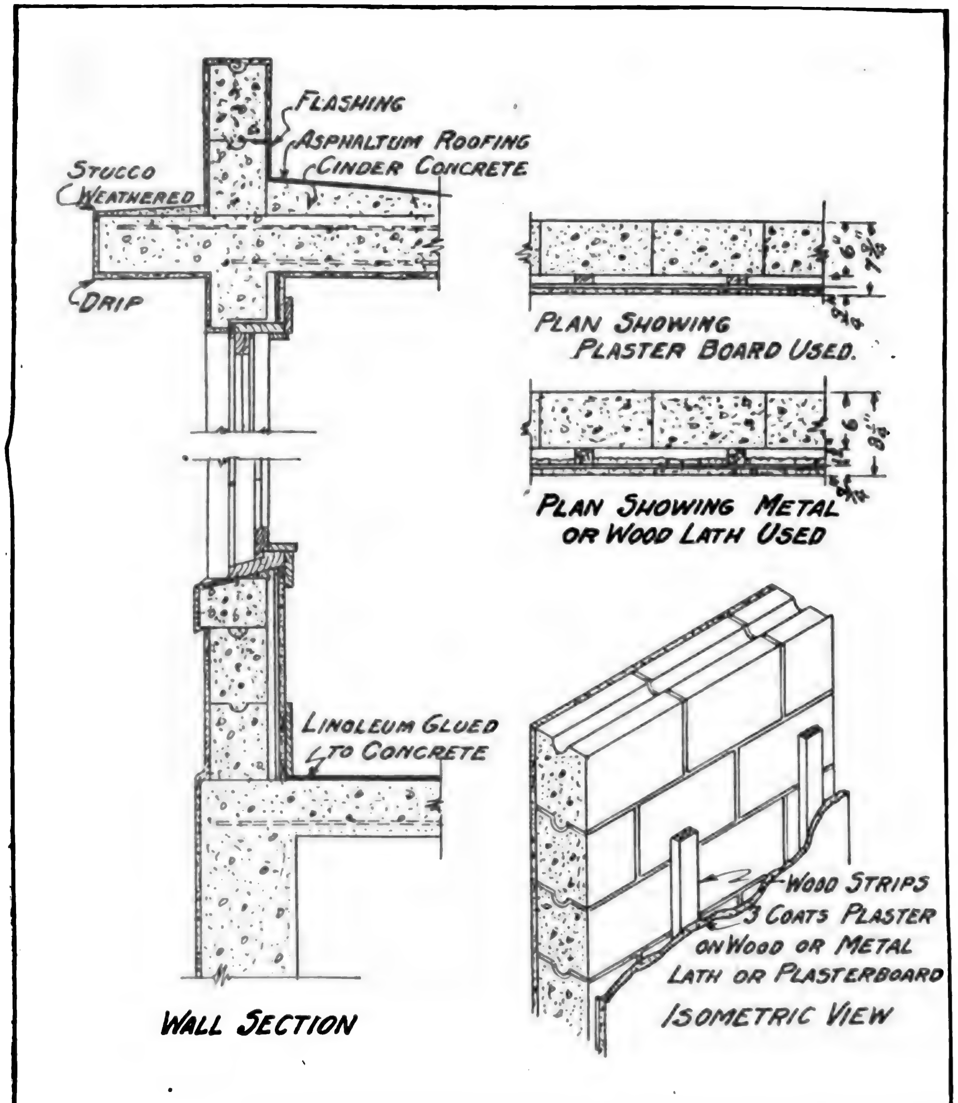


Fig. 8—Detail of the Use of Solid Block of the So-Called Book Type

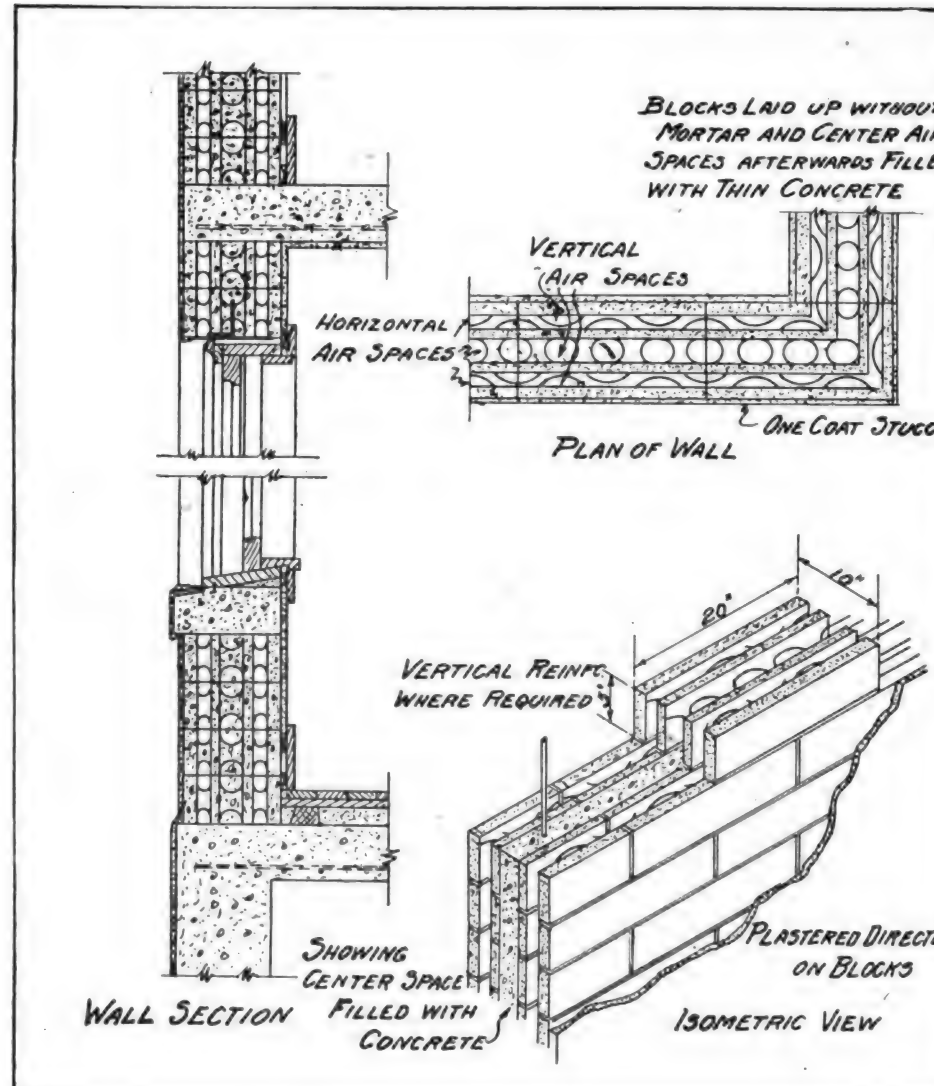


Fig. 9—Detail of Construction with Block of a Type Represented by at Least Two Different Machines on the Market

It provides three series of air spaces, the center one of which is filled with grout, the units being laid up without mortar. This provides for the placing of reinforcing rods, horizontally and vertically.

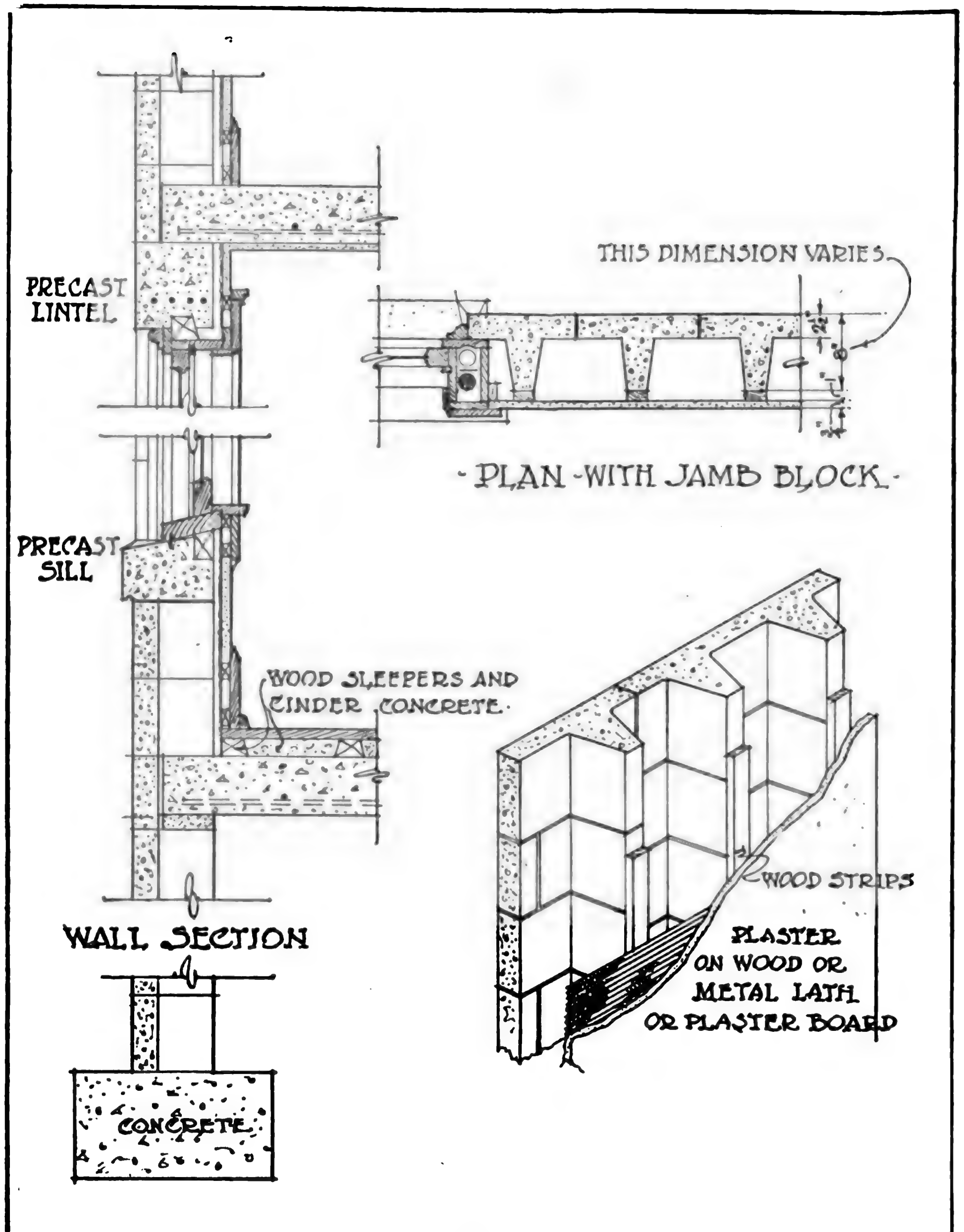


Fig. 10—Detail of Construction with Hydro-stone One-Piece Block, Forming a Series of Vertical Air Ducts by Means of the Projecting Lugs, Which Provide Studs to Which Furring and Lath and Plaster Are Applied

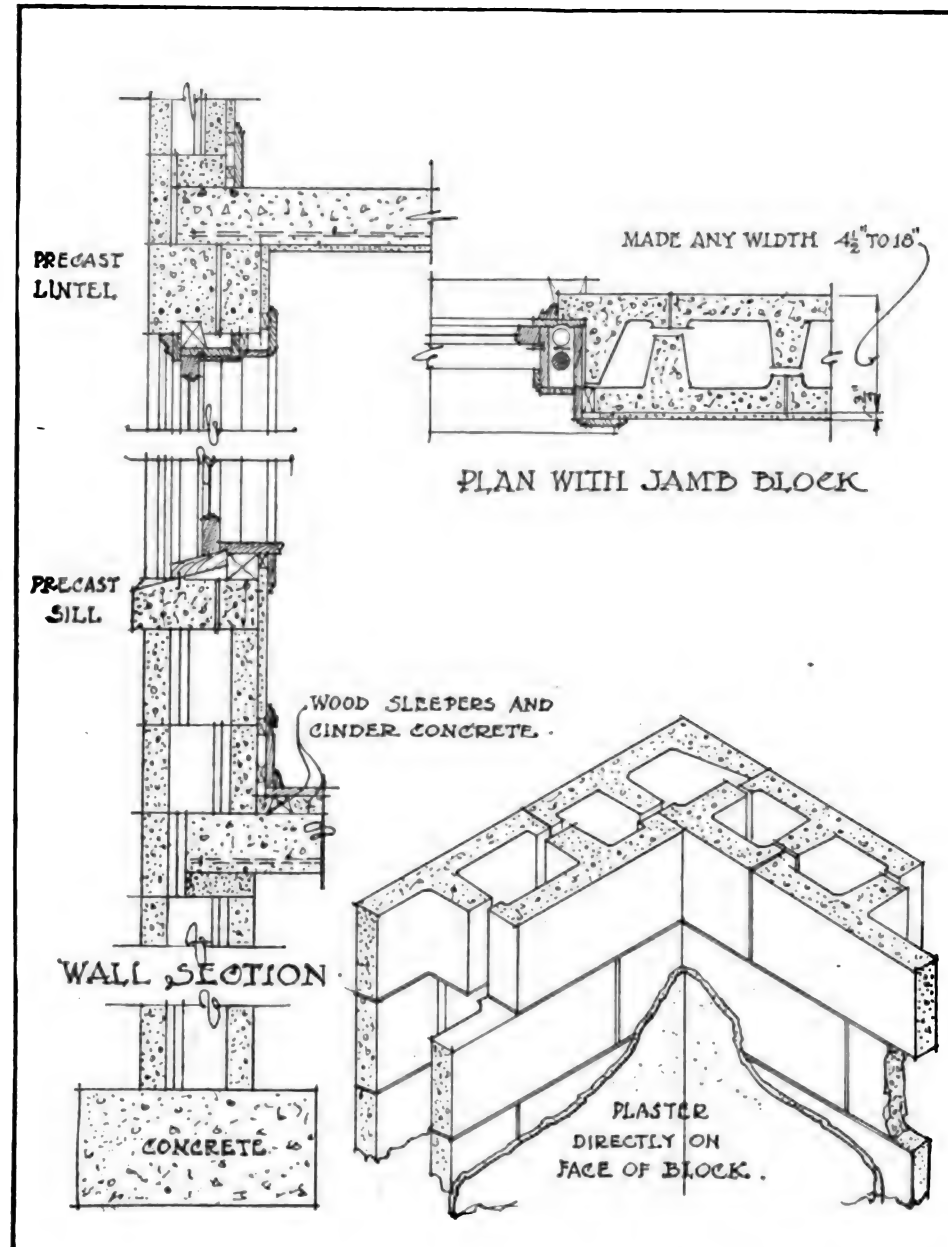


Fig. 11—Detail of Hydro-stone Construction with Two-Piece Block, Forming a Continuous Air Space

Such block may be used as finished with special surfaces or used as a base for stucco outside and plaster direct on the face of the inside block—Details courtesy The Hydro-Stone Co.

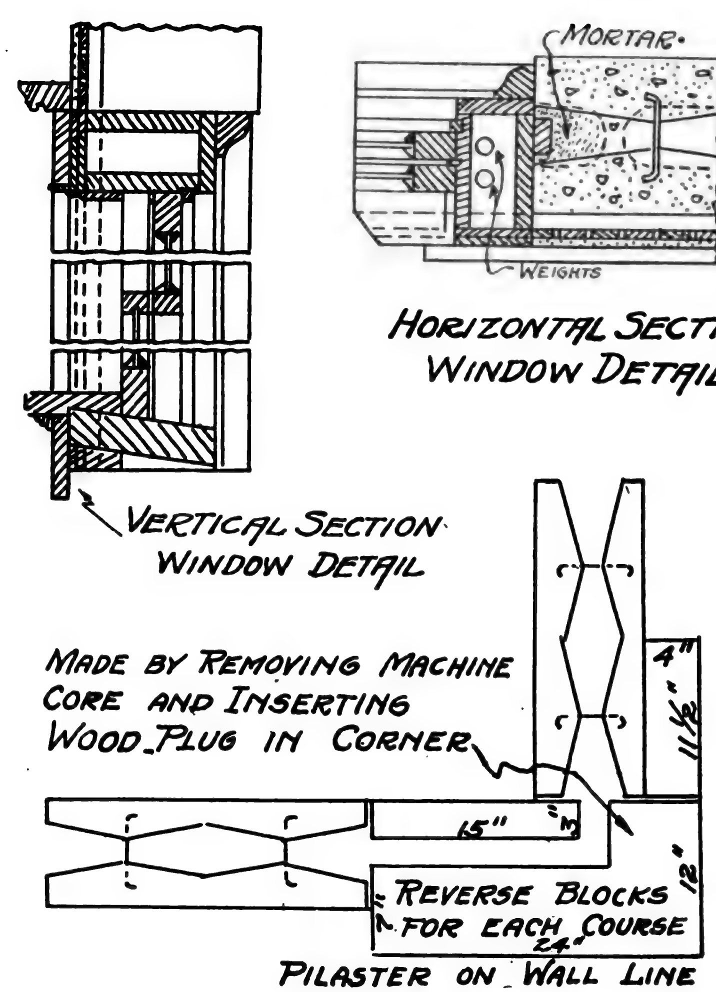


FIG. 12—DETAIL OF CONSTRUCTION WITH WHAT IS VIRTUALLY A TWO-PIECE BLOCK

The two parts are tied together in manufacture by metal ties. The lower detail shows the use of pilaster block for corners of buildings or to be used at intervals in long walls requiring additional strength.

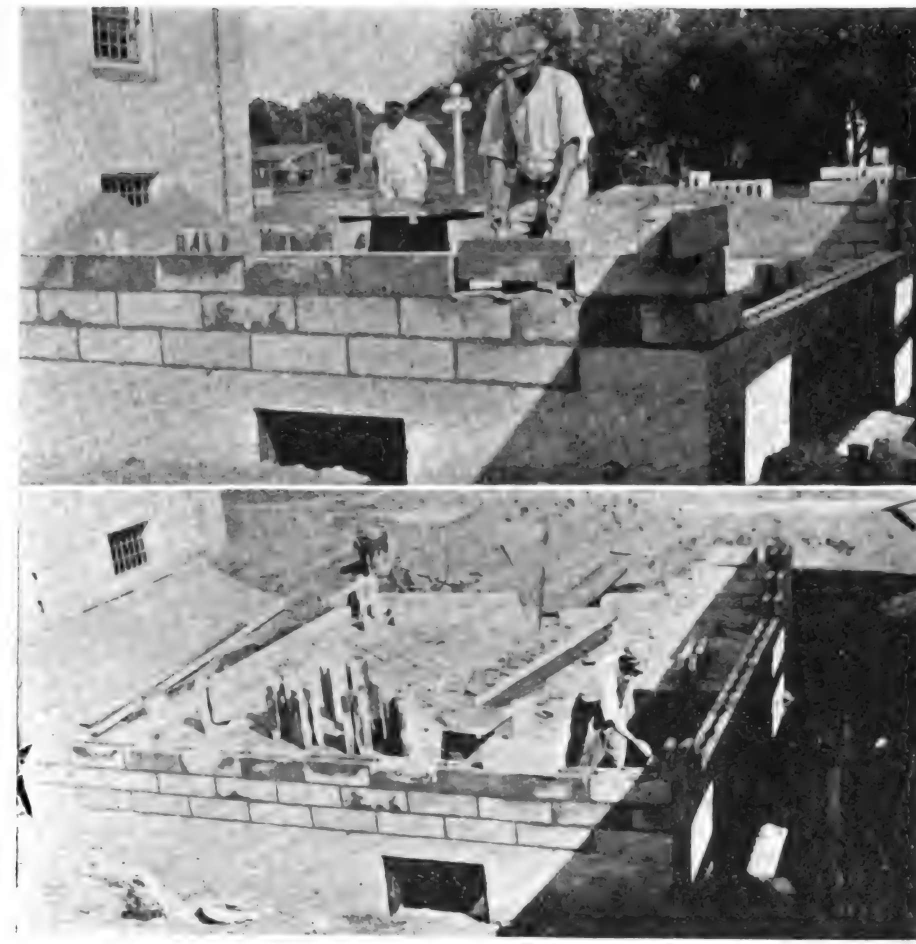


FIG. 13—ILLUSTRATIONS FROM PHOTOGRAPHS, SHOWING CONSTRUCTION IN PROGRESS, WITH BLOCK OF THE KIND SHOWN IN FIG. 12

There are available at least two different makes of machines for block on this general principle; these particular details, however, show the Anchor block—Courtesy Anchor Concrete Machinery Co.

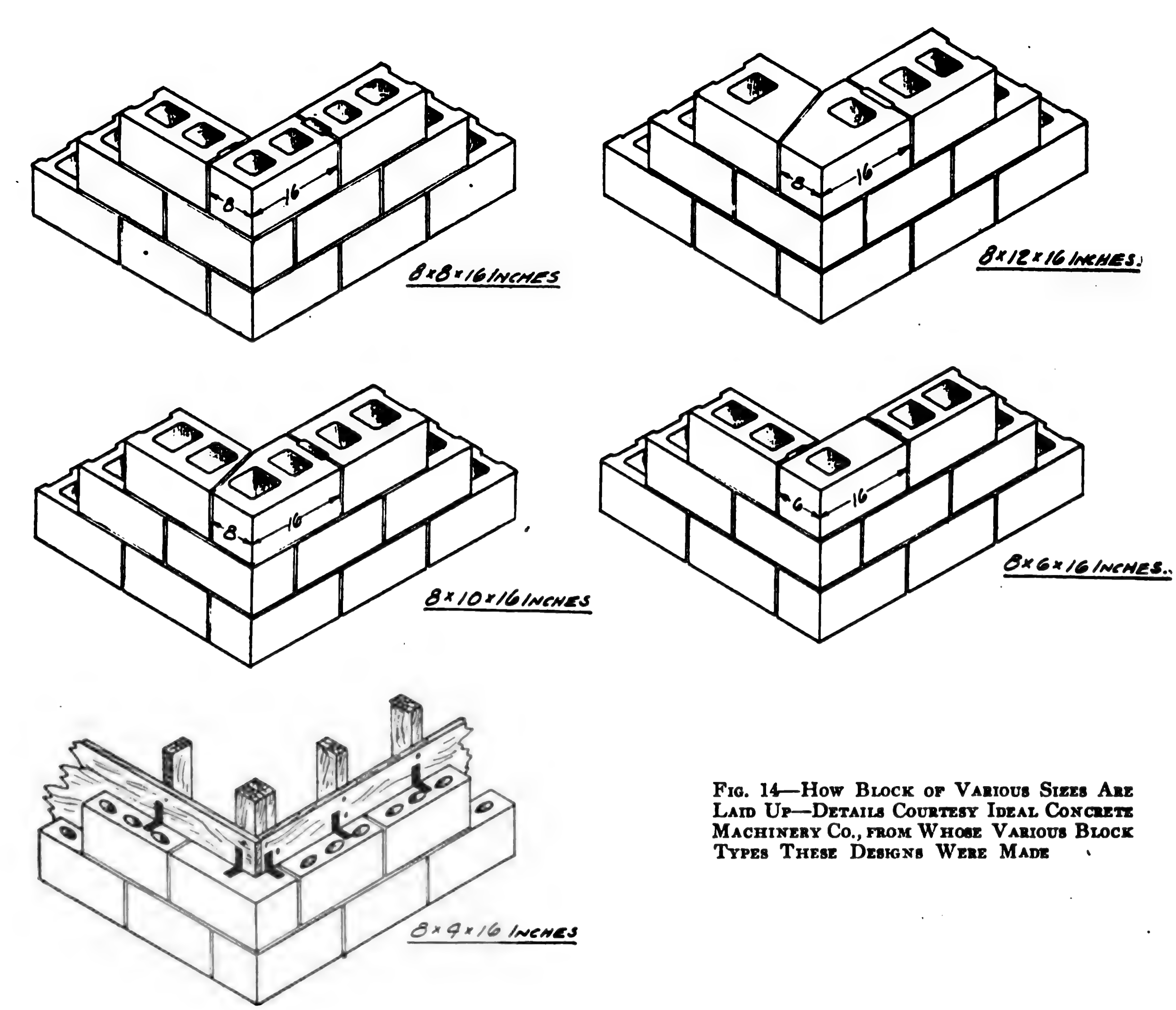
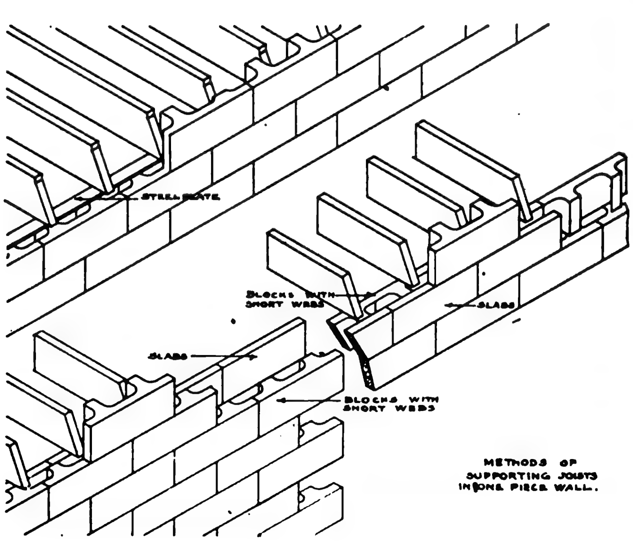
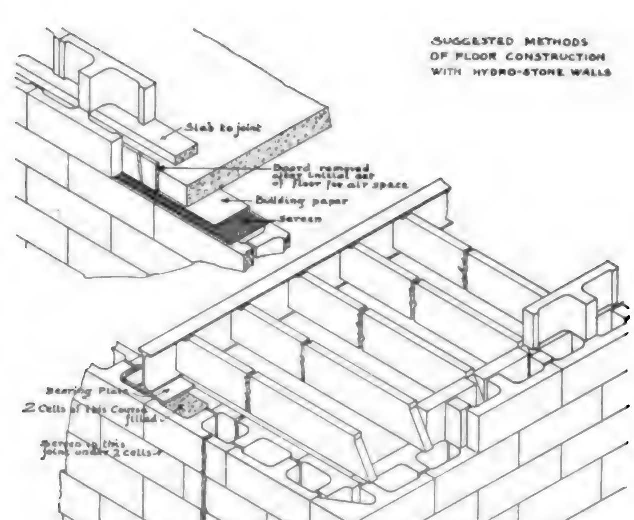


Fig. 14—How Block of Various Sizes Are Laid Up—Details Courtesy Ideal Concrete Machinery Co., from Whose Various Block Types These Designs Were Made





Figs. 15 and 16—Details of Floor Construction, Wood Joist and Concrete, with One-Piece and Two-Piece Hydro-stone Block

Precast Unit Houses at Forest Hills Gardens[1]

GROSVENOR ATTERBURY, ARCHITECT

BY FREDERICK SQUIRES

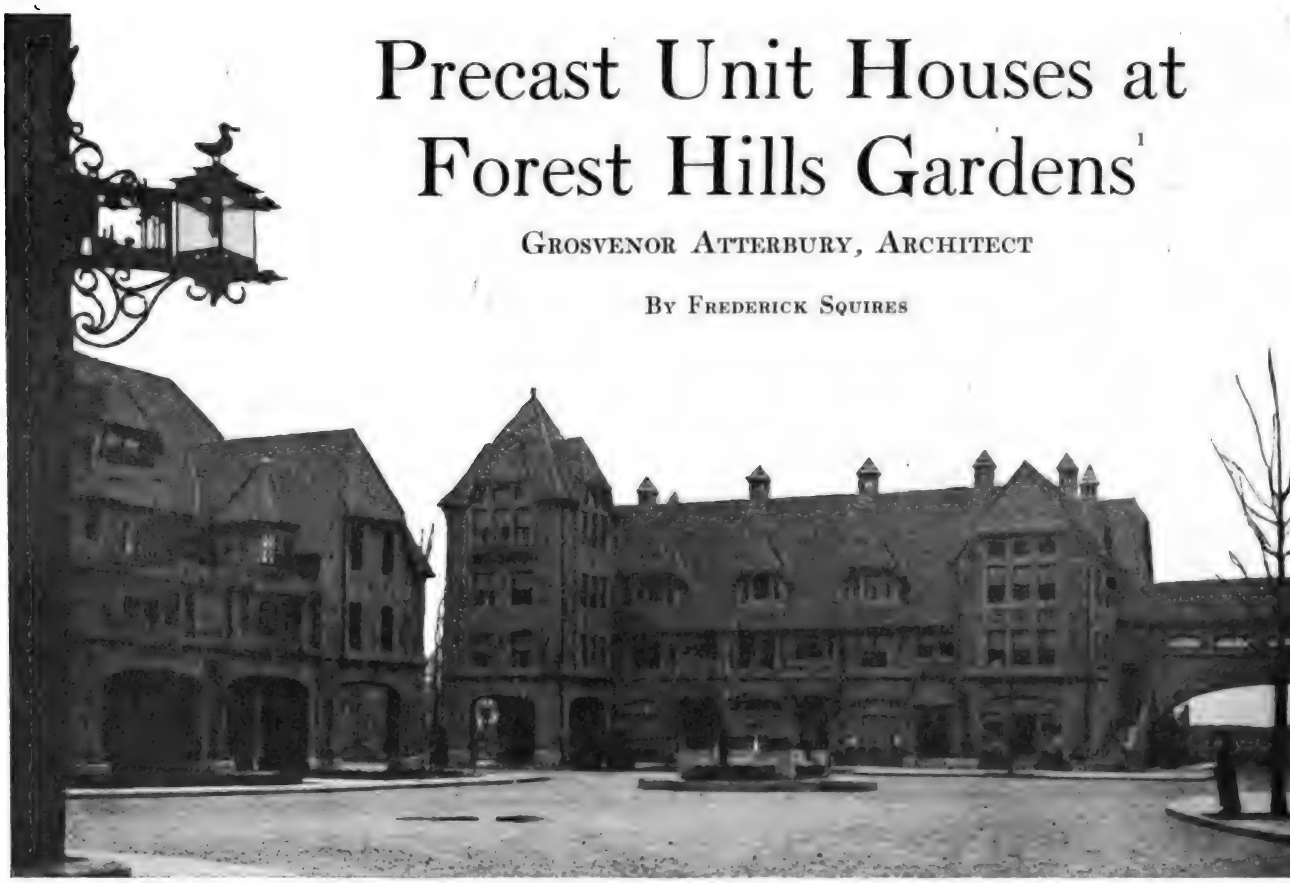


FIG. 1—PLAZA AT BUSINESS CENTER OF FOREST HILLS GARDENS, LONG ISLAND

A house of pre-cast concrete block is no new thing, in fact, concrete was first of all used for residences in the form of small pre-cast block to be set by hand. The size of the building unit has usually been pre-determined by some peculiarity of its manufacture, brick, for example, being small because only small pieces of clay can be burned successfully. In other cases where there is no such limitation in manufacture, the size is made convenient for handling, both while being made and while being used, as in the case of hollow tile, stone and wood. This is the only reason for the size or rather the weight of the average concrete block, one of whose dimensions is in most cases a wall thickness. Steel is so heavy in proportion to its size that almost all its structural sizes are too heavy to be handled without the use of machinery, but for all high structures its obvious advantages far outweighed this handicap. Grosvenor Atterbury, in the development of Forest Hills Gardens for the Sage Foundation, has applied the methods of handling steel to pre-cast concrete block for certain of the dwellings.

As monolithic concrete construction advanced, it became increasingly customary to pre-cast certain of the structural parts, beams at first, but finally even columns and slabs, although often the slabs were poured in place after erecting the frame work. Ernest Ransome perfected this method for commercial work, and meanwhile Mr. Atterbury, a New York architect, was conducting scientific experiments looking to the use of large pre-cast concrete slabs for floors and walls of dwelling houses.

These studies began about 10 years ago, and for the last five years or six years the experiments and demonstrations have been conducted under appropriations made by the Russell Sage Foundation. As the result of this work Mr. Atterbury has developed a system of building construction whereby mechanical devices have made practicable the use of pre-cast concrete block many times larger than the old concrete hand unit.

It may be worth while first to get a broader view of the interesting place of which this group of pre-cast slab houses forms a part. The very introduction to the place, the railroad station, usually the most distressing feature of any American town, is at Forest Hills a place of excellent design, stucco covered and largely built of concrete. Seen from its platform is a picturesque new-old quadrangle, all the buildings forming it tied into an unique composition by bridges, and its interest magnetized by a tower, a structure steel framed but floored with concrete.

These buildings are concrete paneled, with fields of brick work; the tone of the concrete is obtained with an aggregate of broken roof tile, which corresponds pleasantly in color with the red tile roofs. The pierced designs of the chimney tops and the exquisite texture of the concrete fleche finishing the tower are particularly worthy of attention. Nowhere is the trademark of good taste more clearly printed than in such uses of a much-misused material. The views of this quadrangle show, in the sidewalk arcades, how easily overhanging stories may be accomplished in concrete construction. Passing through the courtyard and looking back on it from the main road, there is a scene for picturesqueness not equaled anywhere in America, and for an artistic use of concrete unequaled in the world. Pierced chimney tops, beautifully toned stucco, concrete paneled walls, fountains, tea-houses, ramps, fleches, balconies, all executed with wonderful charm in a material for which a great English architect studiously denied the possibility of artistic expression. For years in New York City Italian

[1]From CONCRETE, Jan., 1915, p. 3. For a statement of the original program of Grosvenor Atterbury, architect for the Sage Foundation, see *Cement Age*, Dec., 1910, p. 315. Data for the present article were supplied by Mr. Atterbury.—Editors.

FIG. 2—DETAIL OF CONCRETE HOUSE IN GROUP 2, ERECTED FOR THE SAGE FOUNDATION HOMES CO. UNDER MR. ATTERBURY'S SYSTEM OF HOLLOW SECTIONAL CONCRETE CONSTRUCTION

FIG. 3—VIEW OF TOWER AND BUSINESS CENTER AT FOREST HILLS GARDENS

FIG. 4—VIEW OF RAILROAD STATION, SHOWING PRE-CAST CONCRETE GRILLES, BRUSHED CONCRETE STUCCO WALLS, AND HALF TIMBER APPLIED IN SITU OVER TERRA COTTA BLOCK

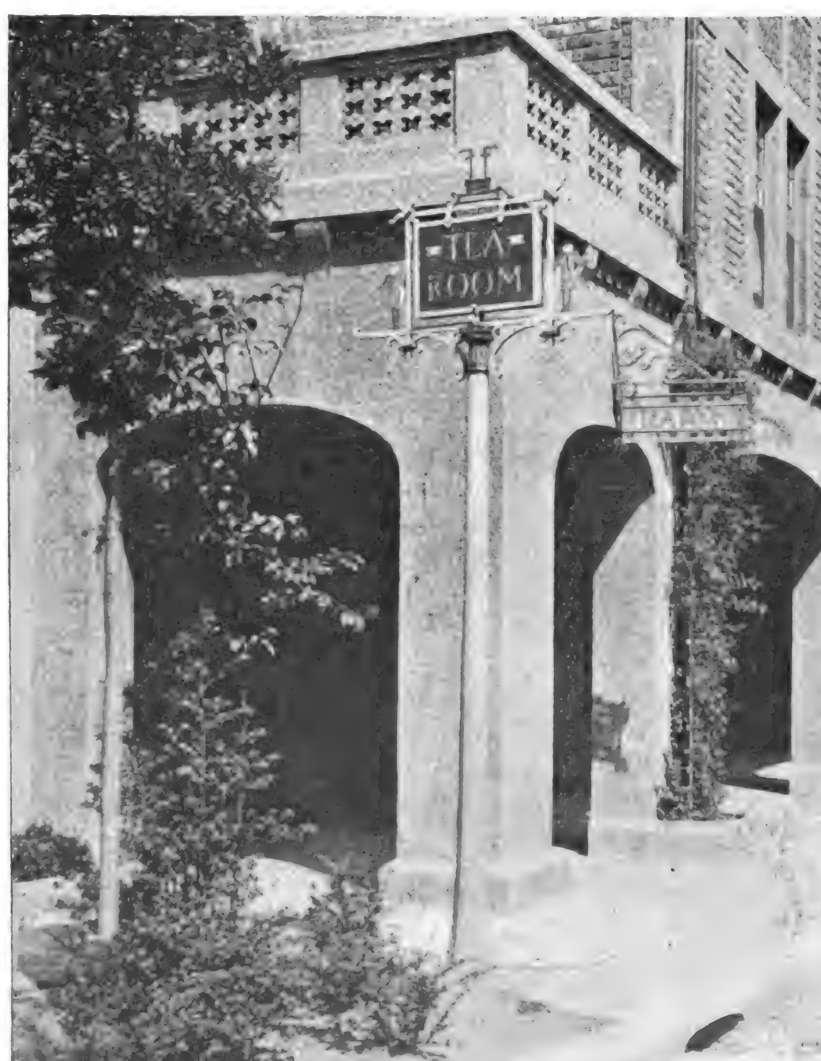


FIG. 5—DETAIL SHOWING TEXTURE OF BRUSHED CONCRETE WORK APPLIED IN SITU WITH COLORED AGGREGATE

Fig. 6—Portion of Group 6, Forest Hills Gardens, L. I.

Shows in upper stories concrete half-timber work composed of pre-cast hollow sections made in the factory, reinforced and filled in erection; terra cotta block and brick panels inserted, also brushed concrete grilles, copings on terrace walls, and gateways.

and Greek ornamental plaster makers have been casting lovely concrete images and engineers have been designing concrete buildings. Mr. Atterbury has brought the two together.

Much of the beauty of the group cannot be shown in the illustrations, the colors of the exposed gravel aggregates and the crushed red tile playing an important part in the general effectiveness. There is a warmth of hue which has been attained only occasionally in concrete work. The reproductions from photographs do show texture, however. Even the concrete sidewalks are obviously not "cement sidewalks," as the aggregates have been exposed.

While the general appearance of the main groups is similar, in that almost all of the exterior walls are paneled with concrete bands or half timber, which represent the horizontal and the vertical reinforcements in the walls, they are in some cases formed in the ordinary way by using terra cotta block reinforced and covered with concrete stucco on the exterior, the intermediate spaces being filled in with a veneer of brick; while in other cases it is a true reinforced concrete skeleton building in which panels are formed by the erection of pre-cast tubular concrete timbers reinforced and filled after erection at the building. This method of construction—the employment of what may be called permanent molds—is the intermediate step between the ordinary *in situ* process of concrete construction and the factory-made sectional system illustrated in the figures of the group of 14 houses erected and now occupied for something over a year at Forest Hills Gardens.

It will be best to preface the description of this group of pre-cast houses with a visit to the factory where the units are made. From the casting shed or head house an overhead electric crane runs out through the storage yard, where wall, floor and other sections are stacked ready for transportation on small cars running over an industrial railroad to the building site.

The entire process—manufacture, transportation and erection—involves only three necessary handlings of the

Fig. 7—Group 2, Forest Hills Gardens, L. I.

Of this group the 10 small houses were erected under Mr. Atterbury's system of hollow sectional concrete construction, the four larger ones being composite in type, with roofs, floors, and partitions of various fireproof methods of construction.

units. After being poured from the mixer into the steel molds and partially hardened, the sections are lifted out on false bottoms by the electric crane and finished while still green; as soon as they are hardened they are lifted off the false bottoms and placed on the transportation cars in the storage yard, to be handled for the third and last time when they are picked off the cars and set in their proper places in the building by the erecting crane.

The actual time during which labor is put upon these sections, from the gravel bin to their completion in the building, amounts to less than five hours. The minimum time for seasoning, during which no labor is put upon the block, is approximately three days for the wall units and one week for the floor sections. Replacements were actually made and set in the buildings within three days at Forest Hills and 20′ floor sections have been handled one week after casting. A longer time, normally, should, of course, be allowed for manufacturing and seasoning. But with a proper plant and good conditions, the erection work can begin within two weeks after the commencement of manufacture. This includes the time necessary to finish completely both the exterior and the interior of the wall sections, for the system contemplates the omission of lath, plaster and interior trim, the section being molded on the interior side so as to form panels in the walls of the rooms.

Fig. 8—Detail of the Town Center, with Tower and Arched Street

The process of erection is designed so as to eliminate as much as possible the scaffolds, temporary supports and the waste time consequent upon the ordinary construction, where one trade follows another and is more or less dependent upon prompt cooperation.

Fig. 9—Balcony, Showing Use of Pre-cast Decorative Brushed Concrete Panels of Colored Aggregate and Colored Concrete Mosaic Backgrounds

In this operation the time occupied in lifting the block from the transportation car and placing it in position in the building, trued up and wedged ready for grouting, averaged about 20 minutes for each section. As a matter of fact, owing to the shape of the group, it was impossible to keep the crane busy, since the greatest number of houses erected at one time was five. On a straight group, where the crane could move readily up and down the track, without having to be turned, the speed of erection could undoubtedly be doubled. Even under the existing conditions the records show that in the first operation, covering three small houses, the concrete shells were completed and ready for the finishing trades—plumbing, heating and painting—in six weeks from the laying of the foundations. This was at the rate of a house in two weeks, and was accomplished by laborers who, with only one exception, had never before seen the system in operation.

The second group of four 18′ houses was erected in five weeks, or at the rate of a house in nine days.

As the curing process occurs in the factory before beginning erection, the speed of erection and completion under this system can be pushed to its economic limit. It is evident from the records of the demonstration at Forest Hills Gardens that sectional houses in groups can be erected at the rate of one a week and completed by the finishing trades, ready for occupancy, in two months from the first delivery of sections at the site. In the buildings at Forest Hills, which had to be finished to correspond with the high class structures adjacent to

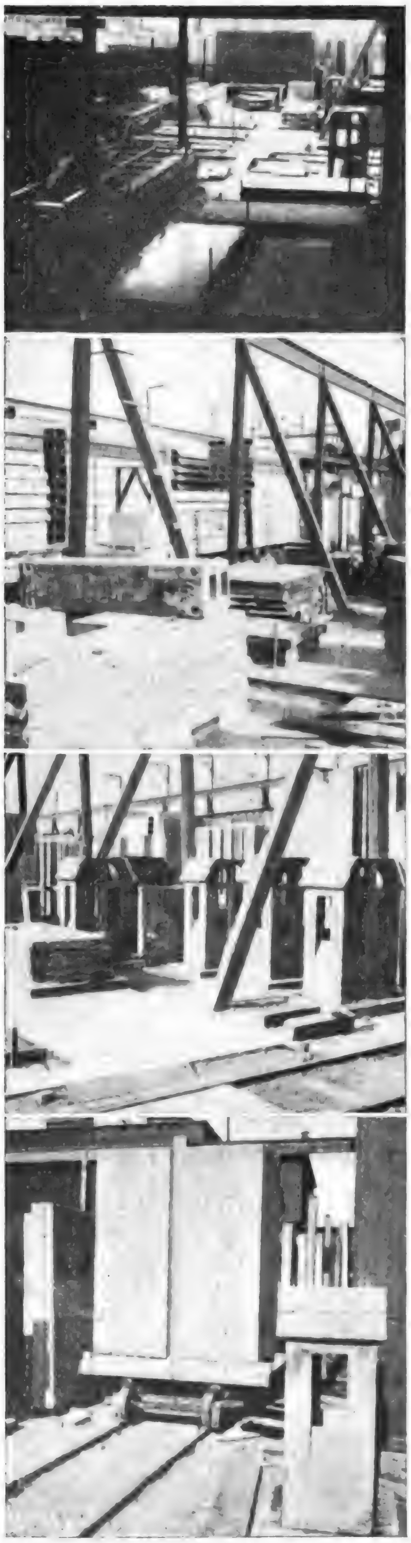


FIG. 10-13—VIEWS AT FACTORY FOR PRE-CAST UNITS AT FOREST HILLS

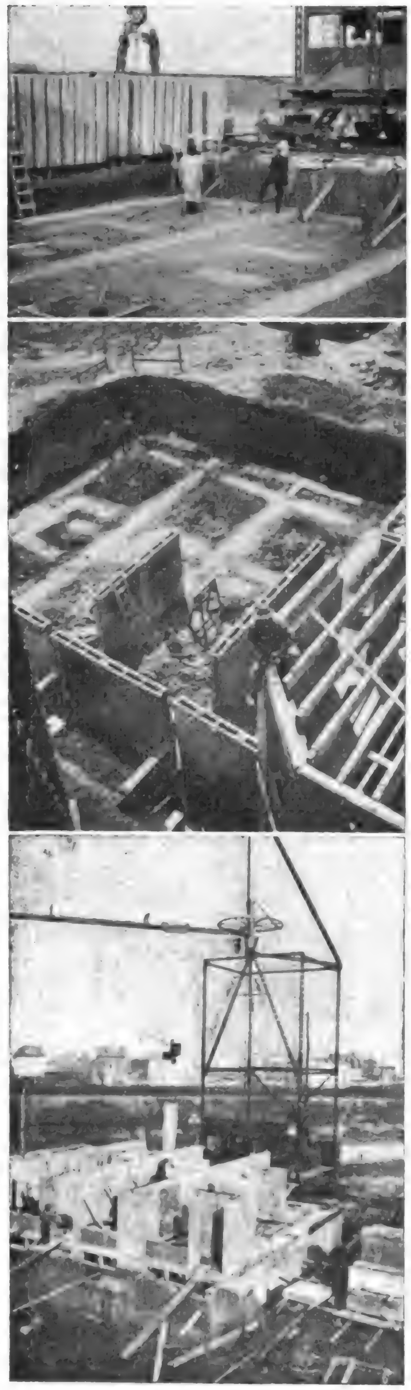


FIG. 14-16—SUCCESSIVE VIEWS OF BUILDING OPERATIONS WITH CRANE PLACING UNITS

FIGS. 17-19—DETAIL VIEWS OF PRE-CAST UNIT HOUSES UNDER CONSTRUCTION

them, seven weeks, or eight weeks, were spent in finishing and decorating the interiors.

While in a majority of the houses the interior surfaces of the walls are all of concrete, as before explained, certain of the houses are plastered directly on the wall sections and have floors constructed of pre-cast concrete beams. These concrete beams had on top and bottom a surfacing of a cementitious nailing mixture into which floors and lathing were nailed. The same product of the factory was used on the roofs as a nailing surface to receive the tile.

Among other by-products of the demonstration work at the factory there has also been developed a hollow wet process concrete block, with a brushed surface of ordinary hand unit size, for use in buildings not permitting the introduction of the large and undoubtedly more economic standard sections.

While the factory has thus been used for all the various products employed at Forest Hills Gardens, the plant, as was to be expected, has not justified itself commercially through the products utilized so far in the buildings erected with pre-cast units.

So much of the work done has been pioneering, with such large expenditures to be made and remade in various undertakings which were purely experimental, that Mr. Atterbury's achievements in the Sage Foundation undertaking are more a contribution to the science of building with pre-cast units than a successful investment in the immediate work described. Mr. Atterbury believes

that in spite of adverse conditions the commercial possibility has been demonstrated, so as to be available in further undertakings which are of sufficient magnitude to warrant the "wholesale" methods involved.

One of the preliminary decisions arrived at in connection with the manufacture and use of large wall and floor units was this: In order to make it practicable to adopt a really scientific and economic design, all units were to be cast and subsequently handled in the same position as that in which they were to be put under stress in the building itself. The floor units were thus made horizontally and the wall units were cast vertically. The molds for the wall units were in a pit and were faced by the use of a dividing plate with the special facing mixture on one side, backed up on the other with the regular mixture. This in all cases was poured wet. The molds are of steel, the sides hinged at the bottom and adjustable for different thicknesses of slab. Both floor and wall molds were equipped with collapsible or tapered cores, which were steam heated for rapid curing of the wet mix. By this method it was found actually possible to remove a one-ton wall slab vertically from the molds in two hours after pouring, but this was obviously undesirable, as the great heat required "cooked" the concrete so as to deprive it of much of its strength. In practice each mold was never used more than twice in 24 hours. Floor slabs were usually 14′ long, 5′ wide and 10″ thick. Wall slabs were usually 8′ 6″ high, 6′ wide and 9″ thick, cored and having 2¾″ webs and outer and inner shells 1½″ thick.

In the earlier demonstrations the average wall sections weighed a little less than 1 ton, being the equivalent of from 1,200 to 1,500 brick laid in an 8″ wall. Experiments, however, showed that still greater economy could be effected by increasing the size of the units, which now run from one ton to three tons in weight, the practical limitation imposed on their size really lying in the design of the structure itself and not in any mechanical difficulty of manufacture, transportation or erection.

Floor slabs weighing 3½ tons, 11″ thick, 6′ wide and 20′ long, have been successfully handled and tested; although in the 14 houses recently erected at Forest Hills Gardens the houses did not require floor sections more than 14′ in span. Obviously, the success of this idea from a mechanical point of view depended upon the substitution of high power machinery for ordinary hand labor, the key to the situation being an electric crane and derrick.

Surfaces for the interior walls of the houses were brushed over with grout after removal from molds, to fill all pores and pin holes and were then rubbed down to a smooth finish and subsequently decorated. Exterior surfaces in some cases with special facing mixtures, and sometimes with ordinary gravel mix, were scrubbed a few hours after casting—the exact time being governed by weather conditions. This scrubbing was done with stiff fiber or wire brushes at a cost of 1 ct. per sq. ft. Power brushing machines were tried but discarded. At the age usually of two days the scrubbed surfaces were acid washed, to brighten the aggregates. Floor and wall slabs have nailing strips, for securing wood floors and metal eyelets for attaching the derrick chain hooks. The under sides of the floor slabs were cast smooth to be exposed, but they were finished with heavily stippled paint, after erection when the interiors were finished and decorated. The cores are vertical in the walls and the lifting device for handling them operates through them so as to lift the sections from the bottom. There are two patterns of wall block in each story, a slab the full clear story height and a short panel from floor to window sill. Each slab, except for corner use, is tongued on one closed side and grooved on the other.

In the regular 13′ houses, which were the only ones of really standardized construction, each house, including its terraces and walls, contained approximately 140 sections of all kinds, the total in the entire group of 14 houses approximating 2,000; all of these were manufactured, transported and erected with an astonishingly small loss by breakage.

Building operations, in this particular case, were on a cleverly planned crescent-shaped group of attached houses.

The electric derrick, which is moved to and from the building operation on the same industrial rails used for the transportation of units, can be moved by means of its own power, or, as was the case after completion of this group, hauled by an ordinary heavy steam roller. This crane has a lifting capacity of 5 tons with a swing of 270°, a 40′ hoist and a 40′ clear reach, so that it could put the chimney tops on this group of houses, substantially equivalent to three stories in height. It is obvious that such an equipment and layout are too elaborate for economy in any but large operations, the derrick alone costing $7,000 or $8,000.

The subsequent illustrations of the process of erection need very little further explanation.

The electric crane, operating above the storage yards, lifted the foundation block onto cars which followed the tracks laid down for the derrick, and were relieved by it of their burden, which was swung into place on the footings already prepared. When all the foundation walls were in place they were bedded solidly upon their footings by grouting from on top through the core holes and by this method also the tongue- and-groove joint was made perfect. In this group all joints were later coated from the outside with oakum and pointed up over it.

In the original experimental house erected, the floor and wall sections contain rabbets, so as to give a mechanical obstruction to leakage from the outside. This was entirely satisfactory; and in the second house an experiment of omitting this mechanical lock was tried in order still further to economize in the cost of manufacture. For more than a year there was no trouble, even under these conditions, and in view of that experience the same design was adopted for the group at Forest Hills Gardens. Later on, however, trouble was experienced with these straight joints; and as it was too late to modify the design the caulking process was resorted to in order to avoid any trouble of this nature. Obviously in future operations the rabbet will again be introduced, experience having shown that the only vulnerable point is the joints, and almost entirely in the horizontal ones. In no case has experience shown that dampness has made its way through properly cast hollow wall sections of the design here illustrated.

In placing the units, the crane actually handled 2,000 cu. ft. in a day, not working by any means to its full capacity, but handling all the units which could be placed and grouted by eight men. Two of these men attended to placing and six to grouting.

When the basement tier of wall sections had been set and grouted the floor slabs were in turn hooked up by the four corners and laid in their proper positions on the basement slabs and similarly grouted in place. The outermost floor slabs show through the wall, project over it a little and are provided with a wash and drip. The exposed surface was usually arranged to a closed side,

FIGS. 20, 21 AND 22—AT LEFT AND ABOVE, TWO ADVANCED STAGES IN PROGRESS OF ERECTION ARE SHOWN, AND AT RIGHT, THE CORED WALL AND FLOOR UNITS ARE CLEARLY SHOWN

but when the naturally cored end of the slab was exposed it was plugged and finished like a side adjoining floor slabs and its ends and sides were anchored together with iron straps let in and grouted. Abutting ends were grouted together and for this purpose thin sheet metal caps were placed over the upper ends of the wall slabs which carried them so as to hold the grout. Upper walls and floors were similarly constructed.

Wall slabs adjoining an opening have a groove toward it into which were slipped wooden window and door frames. It will be noted that every floor shows through and that every feature of construction writes itself on the outside of the building so that he who runs may read. This is the gospel of architecture and it has scarcely ever been so closely attained in anything but a concrete building.

Pre-casting concrete slabs insures scientifically placed reinforcement, uniform setting and sufficient curing. It is attended by none of the difficulties of adverse weather conditions, untrueness of forms and unpreparedness for load carrying which are the nightmares of the monolith. It makes possible the use of casting machinery and standard molds, so as to avoid all wastage of all kinds incident to ordinary casting work *in situ;* it permits, as well, a reduction of the factor of safety to a more scientific point both in materials and design; it offers opportunity for all the economies incident to factory conditions.

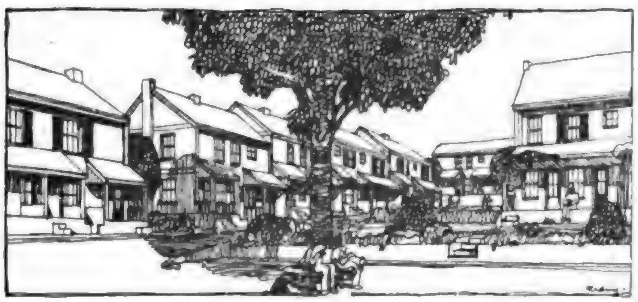
Quite apart from its economic aspects, its stability and its fireproofness—properties common of course to all properly built concrete structures, it is evident from the demonstration described that there is a further distinct advantage in the important saving in time accomplished under any system which manufactures a house substantially in the factory instead of on the scaffold, as has been the ordinary custom. Up to the present Mr. Atterbury's system of standardized hollow sectional construction requires a plant incompatible with economy in small operations, but the same might once have been said about erecting structural steel.

To an architect the most satisfying thing about this crescent of concrete dwellings, set in sharp competition as to appearance with some of the best small suburban houses in America, is that the group holds its own in color, texture and design in spite of the fact that it is composed of "standard" sections made out of ordinary sand, gravel and cement.

281 Fireproof Dwellings Built of Large Precast Concrete Units[1]

By Harvey Whipple

Editor Concrete



In many respects the most impressive industrial housing development in America is to be seen at East Youngstown, Ohio, in the 281 concrete dwellings erected by the Unit Construction Co., St. Louis, for the Youngstown Sheet & Tube Co.

This is not an unqualified statement that the precise methods of concrete construction employed represent the last word in a wholesale undertaking for the construction of fireproof dwellings. The fact remains that in this particular case 281 concrete dwellings of two, three and four rooms each are there—a solid and an attractive fact. The finishing touches are now being put on the last 135 of the number.

The permanent and solid aspect of the development stands out above everything else. Yet the degree of attractiveness which has been achieved is particularly surprising, in view of the fact that duplication of design is an essential fundamental of the methods employed.

This work was described, from a construction standpoint chiefly, in a detailed article in these pages one

[1] Concrete, January, 1919.

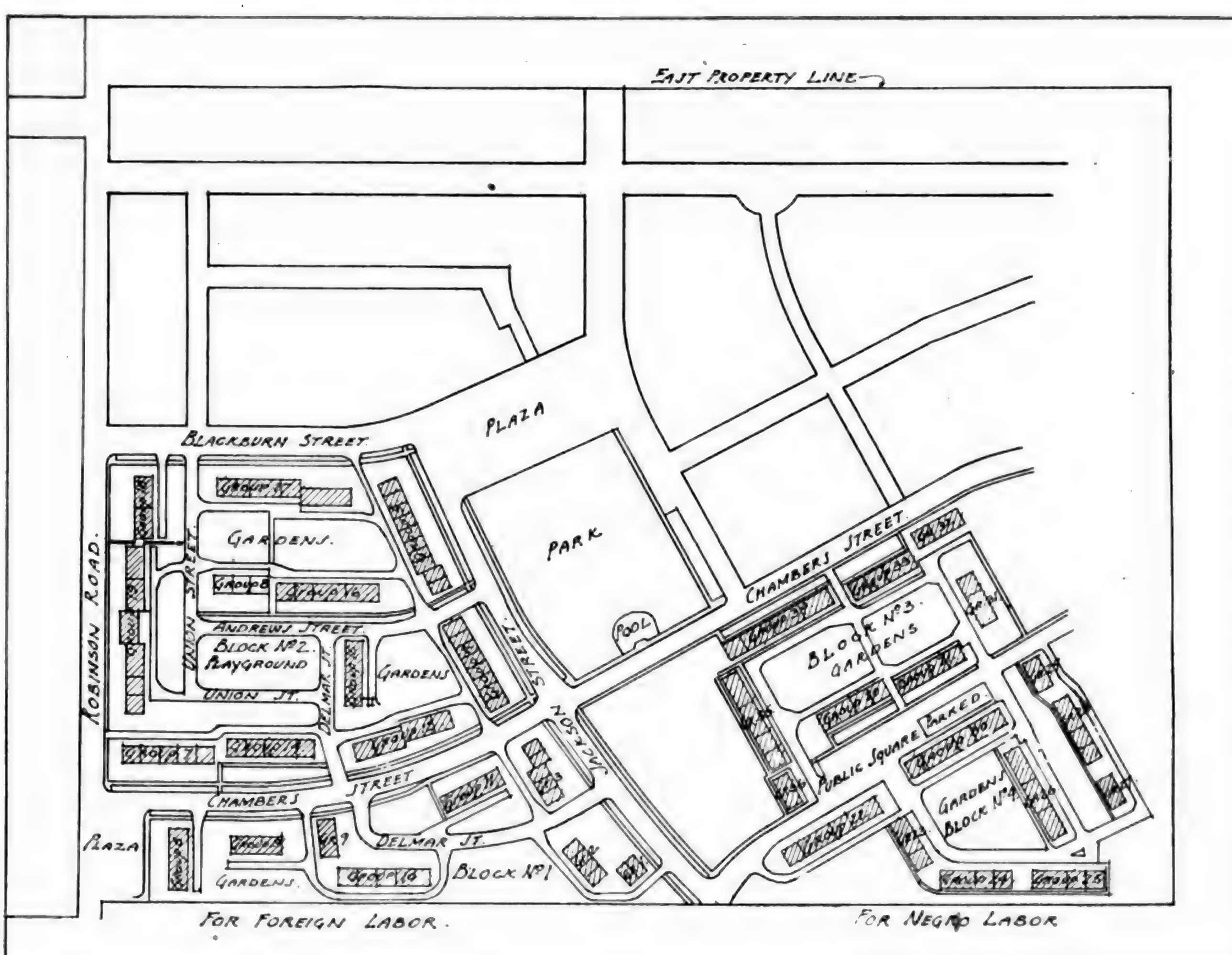
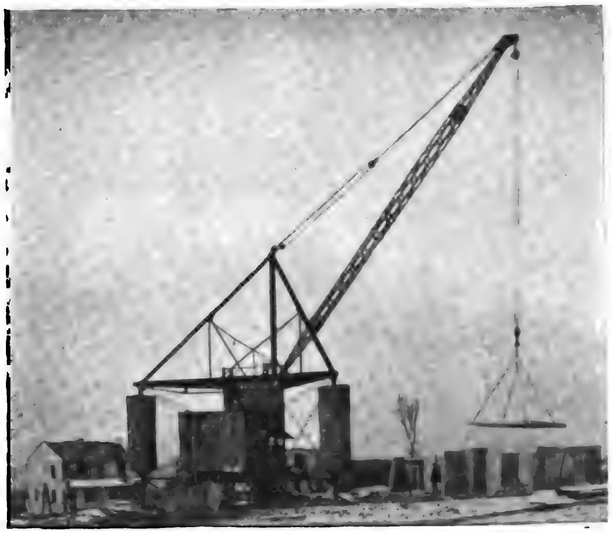
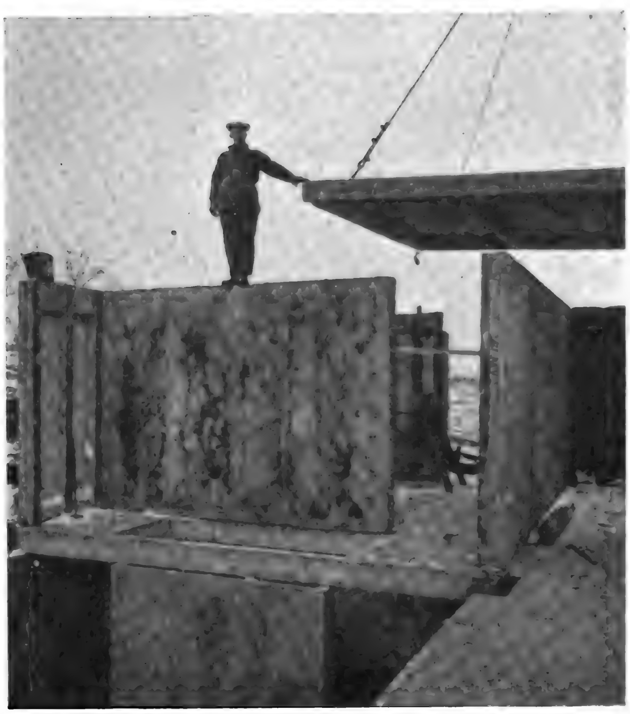


Fig. 1—Layout of Housing Development of the Buckeye Land Co. for Youngstown Sheet & Tube Co. Employees; Designs by Conzelman, Herding & Boyd; Construction by Unit Construction Co.





FIGS. 2 AND 3—PLACING BIG PRE-CAST CONCRETE UNITS IN ERECTION OF 281 HOUSES AT YOUNGSTOWN, OHIO

year ago.[2] At that time ten of the first group of 146 dwellings were nearing completion, with parts cast and in the yard practically ready for setting up of 50 more dwellings. With that article typical plans were presented; a layout of the development was shown, and construction methods in casting and handling the large units were described and illustrated. The first group —for foreign labor—was completed in the autumn of 1918, but before that time work had been begun on the second group of 135 dwellings, comprising the negro colony, and these, in December, 1918, were receiving the finishing touches of paint and plaster.

Briefly summarizing the construction methods described in the previous article;: the Youngstown enterprise was the first use of the Unit Construction Co.'s patents and methods in house construction. A similar idea was, however, applied and worked out with notable architectural success several years previous in the work of Grosvenor Atterbury at Seawarren and at Forest Hills Gardens, both of these operations having been described in this magazine. At the basis of the Unit company's operations is the fact that in a central manufacturing yard large standardized units are cast in simple horizontal molds—one unit being sufficient for half or for an entire side wall one story high, of a single dwelling, or for the entire floor of one room. These units weigh from half a ton to six tons; are loaded with a locomotive crane from the casting area to storage spaces and to five-ton motor trucks, which convey them to the place of erection, where they are placed by means of a big movable hoist.

The Unit Construction Co.'s work heretofore had been applied chiefly to industrial structures, to train sheds, to railway bridges and other work of similar character. In applying these special methods to the construction of houses, the new element lay in the addition of furring, lath and plaster on the inside and of paint to the outside surfaces.

In the manufacture of the standardized units the center of operations is in the mixing plant, the concrete being elevated in a tower and deposited through a chute into a car on a tramway, which serves the casting yard. The concrete is of 1 part cement, 2 parts sand and 4 parts slag. The mix is dumped from a 6 cu. ft. push cart, hand operated by two men on the tramway, which traverses the casting yard, to short chutes conveying the mix by gravity to the unit molds on either side of the track through several hundred feet of casting alleys.

The entire structures in the housing enterprise are of precast units, except for 8″ footings, which are cast in place. The exterior wall slabs are of rib design (3″ slab with ribs projecting 4″, 16″ o. c.—see details); are usually of story height and of a length equal to a room or entire side wall dimension. They are rabbeted at the ends, so that adjacent slabs as set provide spaces for sealing with grout. Ribs, giving a total wall thickness of 7″, were in the early part of the operation formed by boards and sand cores, after the 3″ slab concrete was screeded. The casting method was reversed, however, and ribs are now formed at the bottom and the outside surface of slab troweled on top. Furring strips, asphaltum painted on the back side, are anchored by nails to the ribs when slab is cast. Partition walls were first made tubular, the vertical coring being provided by means of form boxes set in the slab forms as the concrete was poured, these being withdrawn, the spaces filled with sand and the sand later removed by washing with a hose. Changes in casting methods were made when R. J. Blackburn succeeded to the position of resident engineer in charge of the operation, in February, 1918. It was found possible to speed up the work considerably by casting the exterior slabs with the rib side rather than the slab side down. The use of tubular wall slabs was discontinued, as it was found that the economy of concrete by making the slabs tubular was more than counterbalanced by the extra labor. Partition slabs are therefore made 6″ thick solid, instead of 8″, where they serve as bearing walls in the structure. The floor slabs are beamed, the panels being 2½″ thick. These are cast ceiling side down, over well finished wood cores, designed to give a molded trim around the edge of each panel adjacent to the beams. The floor slabs are rabbeted at the outer edge so as to fit over the wall slabs, anchoring the work. Window and door openings are rabbeted and provided with wood nailing blocks cast in. Sills, to get a better finish, are separately cast. Chimneys are cast vertically with vitrified flue in place, and are rabbetted to anchor with the unit slabs when grouted in. Hooks for lifting are cast in the units and cured parts are lifted by a locomotive crane operated on a track throughout the casting area, first to racks (a vertical numbered filing system between stout posts), then

[2]CONCRETE, Jan., 1918, p. 5.

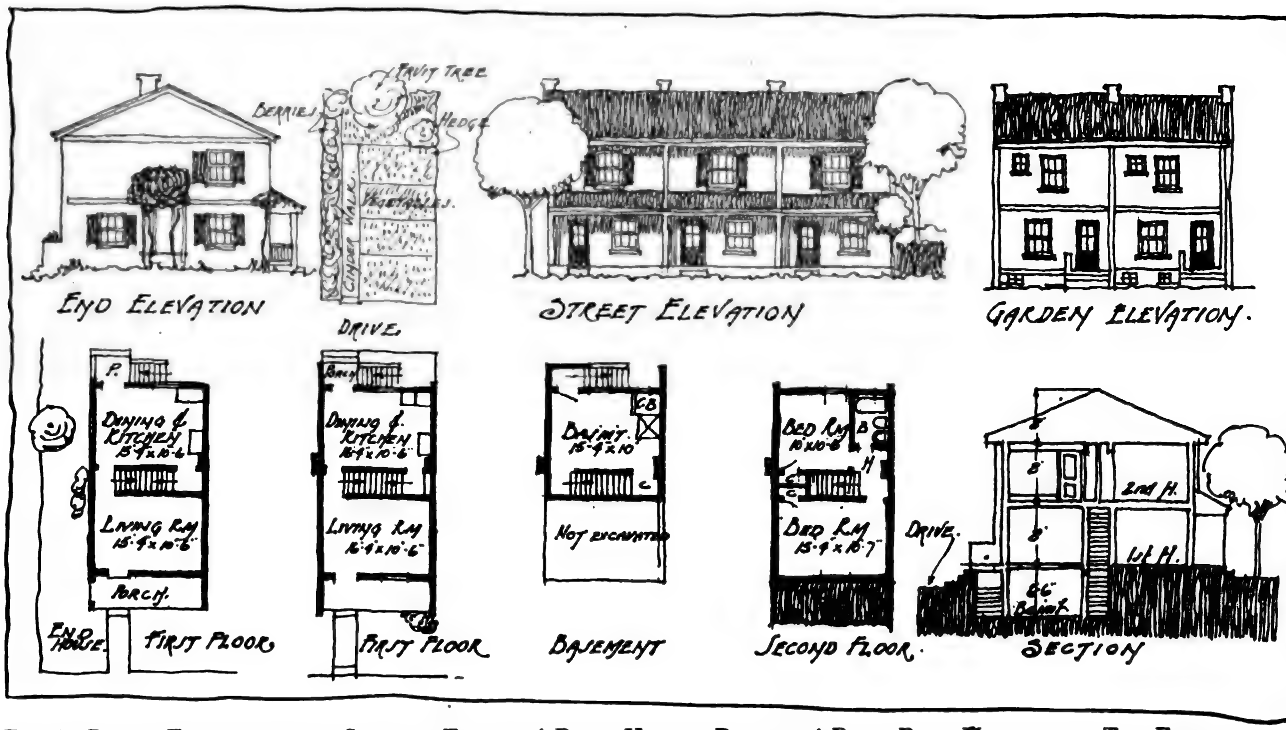
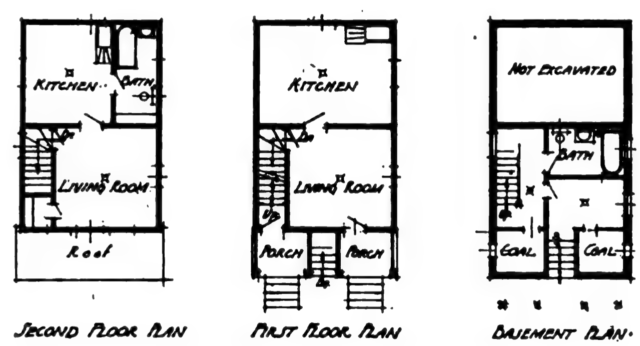


FIG. 4—PLANS, ELEVATIONS AND SECTIONS TYPICAL 4-ROOM HOUSE. BELOW A 4-ROOM PLAN MODIFIED FOR TWO FAMILIES



to five-ton trucks which deliver the units to the immediate scene of erection, where they are picked up by a hoist, each of whose three legs is set on rollers and counterweighted with gravel in the cylindrical hoppers shown in the illustration, reproduced from the January, 1918, issue.

When the house units are assembled, set, anchored, and grouted, the finish is not elaborate. Frames are nailed to the blocks provided at openings, wedged, calked with oakum and plastered over to a neat finish. The inside surface of exterior walls is lathed and plastered over the furring on the wall ribs; wood floors are laid on sleepers over the unit slabs; interior partition surfaces, plastered exterior wall surfaces and ceilings are painted.

The layout of the housing enterprise is illustrated, the later group, for negro labor, being practically shut off by the arrangement of the streets from the group first erected, for foreign labor. Further development for the ultimate housing of about 600 families is in prospect, with a town center including several public buildings.

Plans of a typical four-room house, 16′ x 27′, are shown, together with a page of details including plans, elevations and sections, showing the unit scheme of construction. Since the fundamental requirement for economy in operation in this method of construction, is the duplication of units to as great an extent as possible, the houses are of but few types, monotony and constant repetition being obviated in the layout by irregularity of streets, general spacing of house groups and by stepping of house groups in the plans, as shown in the plan of layout, and also by the unequal topography of the community, with steep grades and a welcome necessity for stepping the construction from one grade to another. This especially lends a great deal of charm to the completed work. This is shown in some of the illustrations from photographs.

The development has been handled by Conzelman, Herding and Boyd, architects and town planners. The construction is done by the Unit Construction Co., for the Buckeye Land Co., which is handling the development as a subsidiary of the Youngstown Sheet & Tube Co. What has been achieved thus far is in some measure indicated by the illustrations from the photographs taken the latter part of December. These pictures show the completed houses in the first group, on which work was begun in July, 1917, and completed in the early fall of 1918. A further idea of the grouping and general character of the development, with its ultimate planning, is indicated in the architects' sketches.

Under Mr. Blackburn's direction concrete work was started after the winter shut-down, early in March, and continued until October. In that period, during which the remaining units for the 146 dwellings in the first

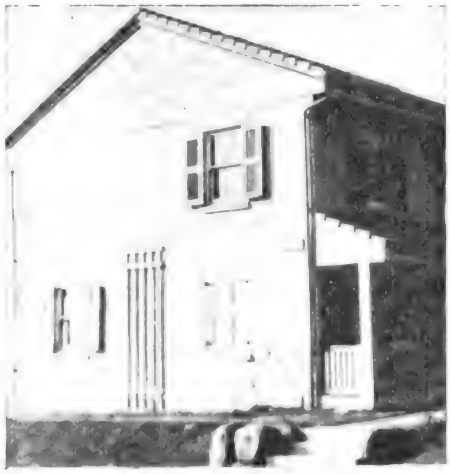
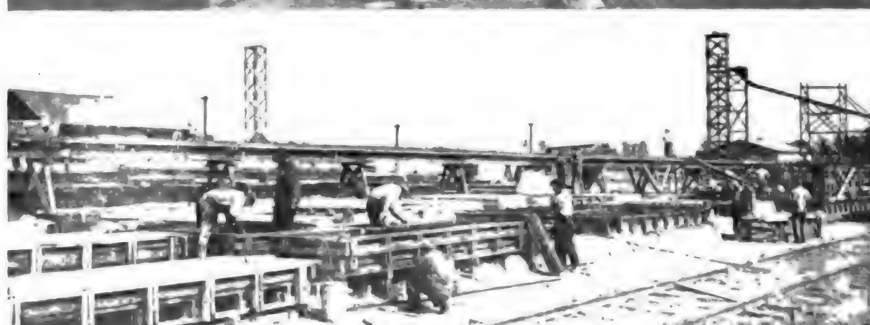
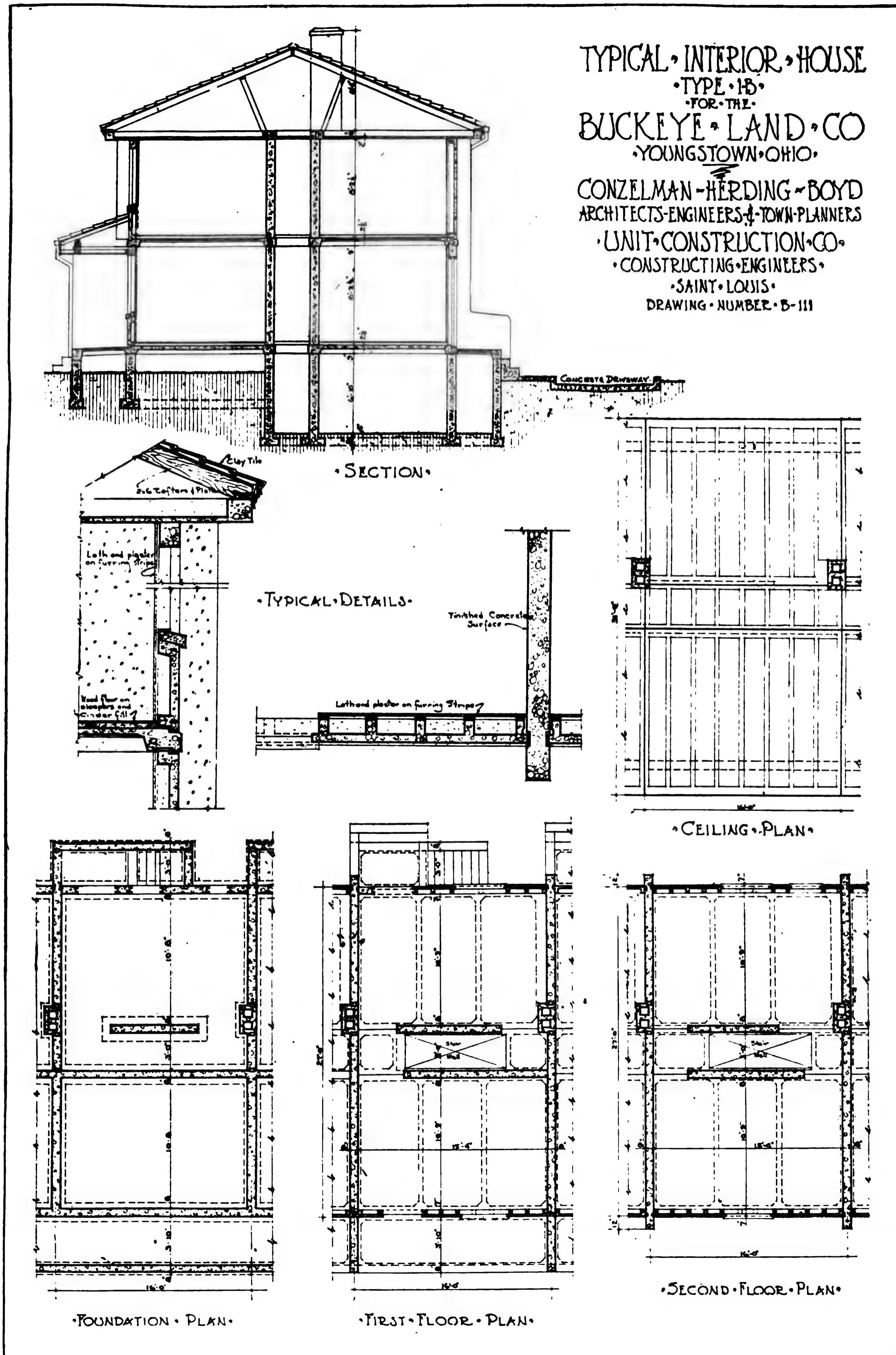



Fig. 5—A Group of Snapshots of Some of the 146 Houses in the First Group for Buckeye Land Co.


Fig. 6—Casting Yard; Track for Locomotive Crane at Left; Casting Area and Tramway at Right, with Tower in Background

Fig. 7—A Near View of Molds for Unit Slabs




TYPICAL · INTERIOR · HOUSE
· TYPE · 1-B ·
· FOR · THE ·
BUCKEYE · LAND · CO
· YOUNGSTOWN · OHIO ·
CONZELMAN - HERDING - BOYD
ARCHITECTS - ENGINEERS - & - TOWN - PLANNERS
· UNIT · CONSTRUCTION · CO ·
· CONSTRUCTING · ENGINEERS ·
· SAINT · LOUIS ·
DRAWING · NUMBER · B-111
Concrete Driveway
· SECTION ·
Clay Tile
Lath and plaster on furring strips
Wood floor on sleepers and cinder fill
· TYPICAL · DETAILS ·
Finished Concrete Surface
Lath and plaster on furring strips
· CEILING · PLAN ·
· FOUNDATION · PLAN ·
· FIRST · FLOOR · PLAN ·
· SECOND · FLOOR · PLAN ·

group and for the 135 dwellings in the second group were finished, an average of 60 yds. of concrete was poured each day and only four days missed, including the Fourth of July, two days of hard rain and one day when the electric power was shut off. The setting up of the units was completed in November, resulting in producing in the period of operation an average of two dwellings a day.

In the construction of the second group of houses, for negro labor, the plans were reversed, making what was the front of the houses in the first group, the rear of the houses in the second group. This was done for the purpose of making the dwellings of this colony face entirely upon themselves in a separate rectangle, and for economy in service features, such as pavements. Another departure in the second group of houses was in providing for some of the tenants two two-room apartments in what was originally planned for a four-room dwelling. The two-room apartment on the second floor has entrance to the basement coal bin from the outside while the remainder of the basement, including a bathroom, is for the occupants of the first story apartment. The upstairs apartment has its rear room with kitchen plumbing, and its stair and entrance are independent of the first floor rooms.

Some special architectural touches are found in this development in the following items: The houses are entirely fireproof (except for the wood floors over the concrete slabs, and a small amount of interior trim), up to the ceiling of the second floor. This ceiling is a fireproof slab and has ventilators with gratings under the eaves. The roof framing, an entirely false structure, is wood and the roofs are covered with red clay tile. In some cases the gable ends are of frame construction and painted with a different color from the wall surfaces. Exterior wall surfaces are covered with two coats of cement paint and window blinds painted green or brown add an attractive touch. Around the steps, porches and terraces good use has been made of all of the loose stone which has been found on the site, in assisting the shrubbery planting in breaking up and adding variety to the landscape.

The thorough weatherproofness of the construction is very well illustrated in the fact that after the ceiling slabs had been finished up on one group of houses and before the roof had been closed in, there was a hard rain so that the ceiling slabs became temporary cisterns, with several inches of water. This was on houses that otherwise were finished, plastered and painted inside. The water stood there for two or three weeks, even after the roof was finished, until the scuppers were finally opened and the flood released. No damage resulted. Houses are to be heated by first floor stoves, with registers in ceiling to second floor.

Although no detailed cost figures have yet been made public in regard to this work, it is understood that on the first group of 146 dwellings the finished cost was about $3,300 per family. On the second group of dwellings the cost has been considerably reduced, and it is believed that they will be finished up at about $2,000 per family. Rentals are being made on a basis of $5.00 per room per month.

In the first group are 74 4-room dwellings and 72 3-room dwellings; in the second group, 25 4-room dwellings, 80 3-room, 30 2-room—a total of 281 dwellings and 912 rooms. Each dwelling or apartment has basement and bath. The ultimate cost per dwelling will depend upon whether or not the plant continues in operation for further construction in the same enterprise.

In connection with costs, it is interesting that what has been accomplished has been under certain serious handicaps. Notable among these—not to mention the labor situation — is the fact that materials have been delivered on the job at an excessive cost for hauling. The work is on top of a hill—the only approach by a steep grade—so that, according to Mr. Blackburn, every ton of material delivered from a railway siding at a distance less than a mile has borne a hauling cost for that distance of $1.25 a ton.

The methods used on this work, making and handling precast house units of maximum size, and of a high degree of painstaking standardization, are not adapted to use in small enterprises. Fifty houses in a single group probably represent a minimum undertaking to warrant the outlay for plant equipment and to permit sufficient duplication to insure economy. Even a fifty-house group could be expected to prove satisfactory from a cost standpoint only under favorable conditions as to materials and labor. It is only in a relatively large operation that there could be any hope to develop that organization and factory system of production which is essential to the realization of the big unit system's special advantages.

FIG. 1—ERECTING PRE-CAST UNIT GROUP HOUSES AT FOREST HILLS

Further Details, Unit Built Houses at Forest Hills

The two articles immediately preceding—the work of Grosvenor Atterbury at Forest Hills and that of the Unit Construction Co. at Youngstown—give interest to the accompanying illustrations of more recent work at Forest Hills in which the Unit Construction Co. and Grosvenor Atterbury effected a combination of their methods, which, due to several special causes (notably war conditions in inability to get suitable materials for brushed surfaces) was not entirely satisfactory in its results.

Mr. Atterbury's idea has been to cast each unit in the position which it would ultimately take in the structure. Floor units were cast horizontally, were handled horizontally, and were placed horizontally, while wall units were cast vertically. Another essential difference between the operations of Mr. Atterbury and the Unit company is in the fact that Mr. Atterbury aims at attractive surfaces, which require no subsequent treatment on the outside and nothing but paint on the inside, a special facing mixture being used on the exposed surfaces of the units, with an aggregate whose character will give attractive results in color and texture—results by mere brushing and washing while the unit is still green. The work done by Mr. Atterbury at Forest Hills Gardens will for a long time stand as an incentive to and an example of the realization of the aesthetic in concrete surfaces and decorative treatment, but it has not fully developed its practicability from an economical viewpoint. Further developments may be looked for in combining the advantages in these two separate ideas in the utilization of large precast units in construction, since in the last year or two the Standardized Housing Corporation, under the architectural direction of Mr. Atterbury, is continuing the work which he began for the Sage Foundation Homes Co. New work at Forest Hills is continuing with the former methods for producing finished surfaces architecturally acceptable and of casting the vertical units in vertical molds.

The work in the accompanying illustrations, which show the manufacturing and erecting methods, was characterized by surfaces so unsatisfactory as brushed out, using poorly sized aggregates, that stucco was applied.

The Standardized Housing Corporation is continuing its work, redesigning manufacturing and erecting methods.

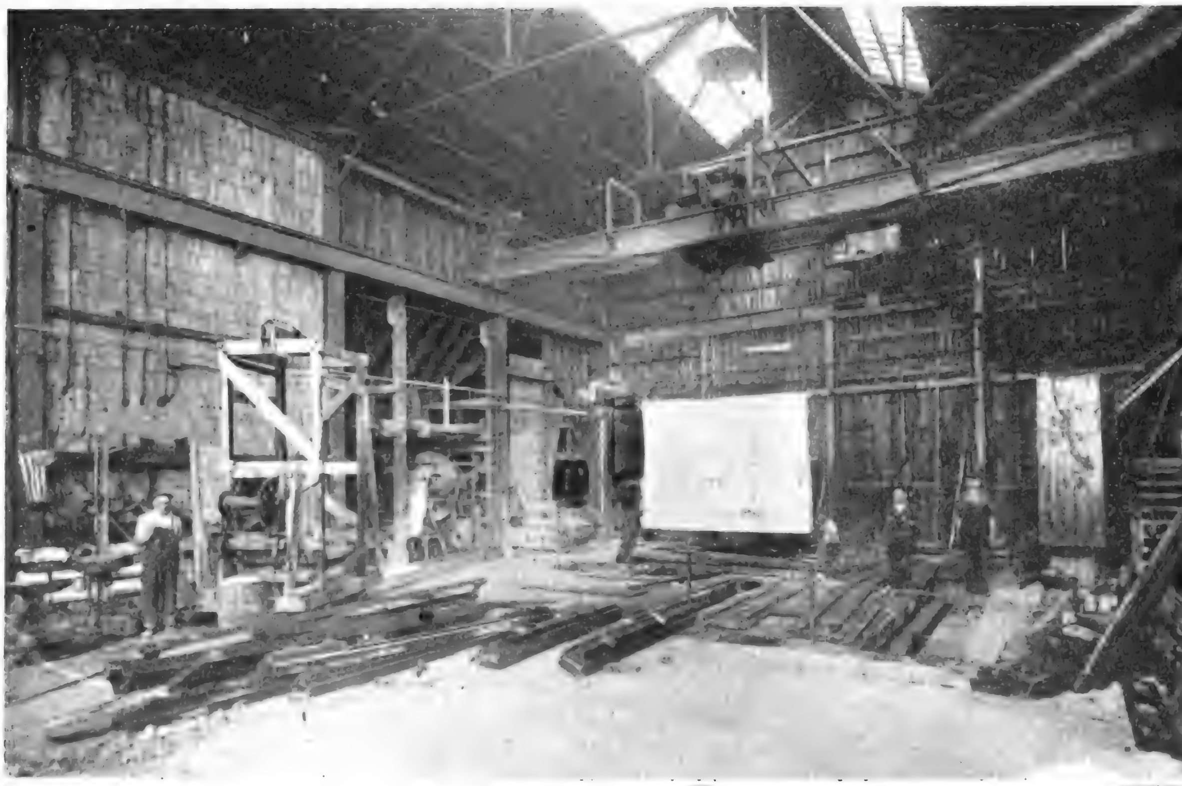
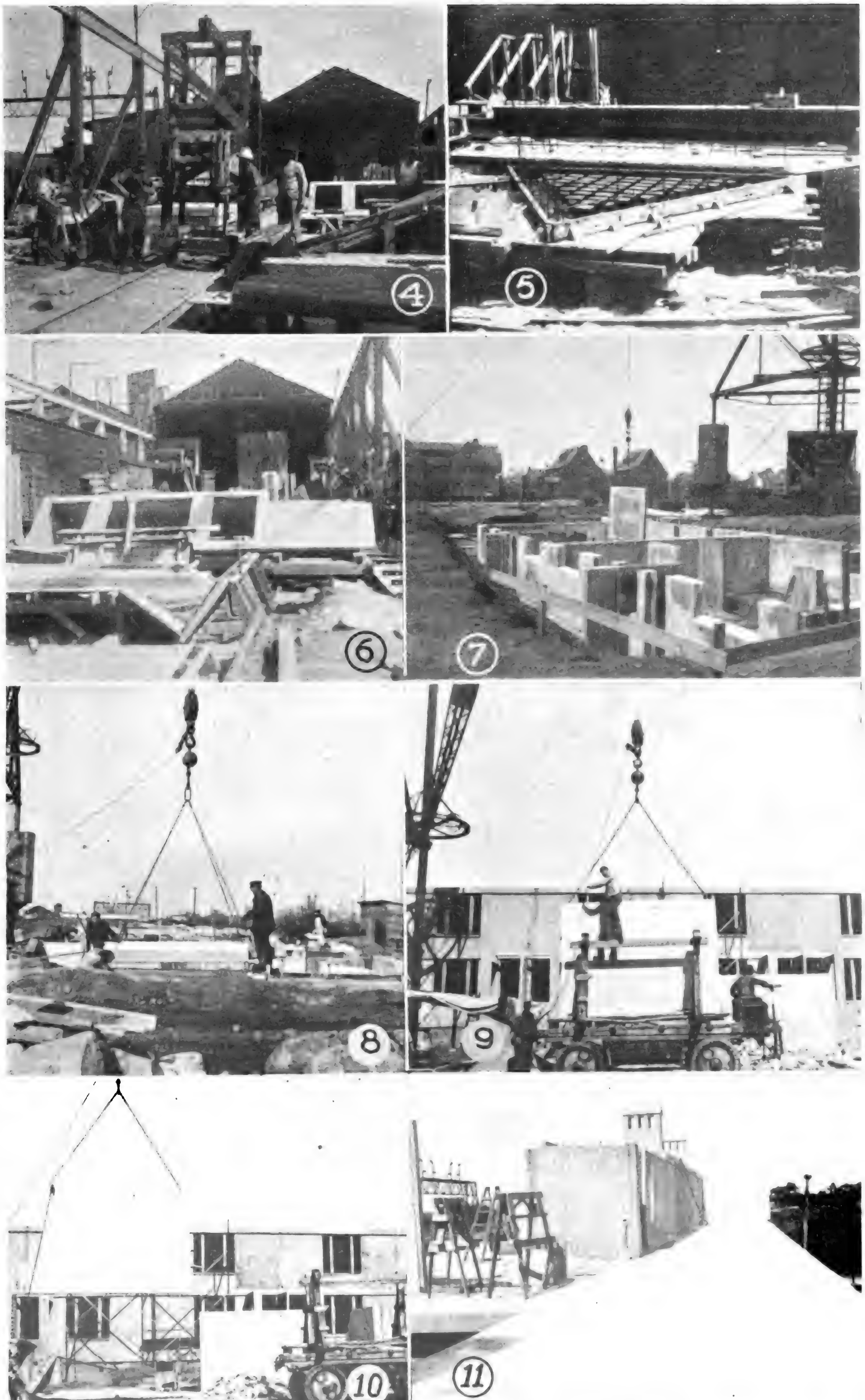


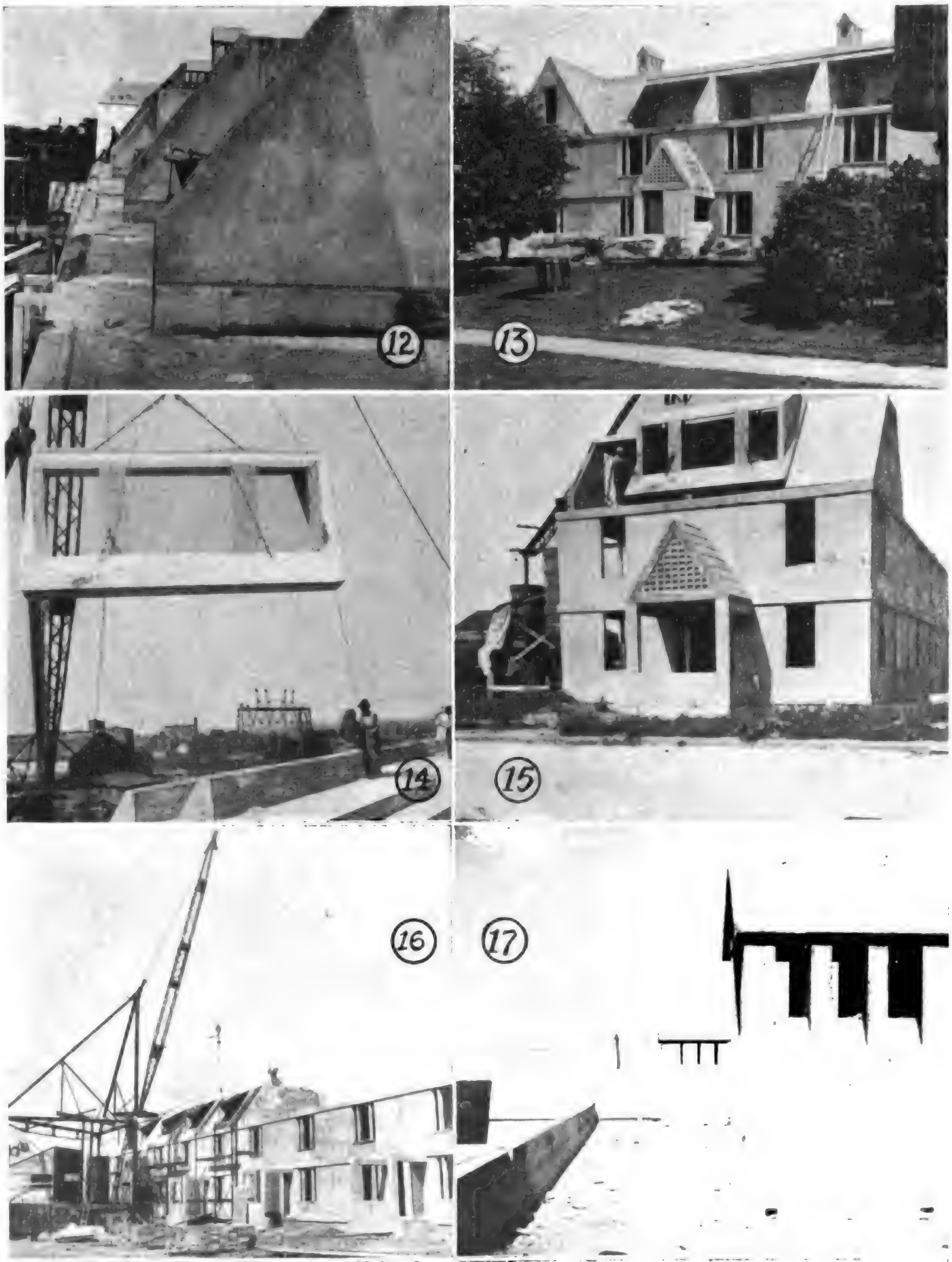
FIG. 2—A WALL UNIT BEING LIFTED BY A CRANE FROM A STEEL MOLD SET IN A PIT UNDER THE FLOOR

FIG. 3—CRANEWAY IN YARD OF FOREST HILLS PLANT



FIGS. 4-11—MANUFACTURING AND ERECTION OPERATIONS

(4) Hopper of concrete mounted on car filled at mixer inside plant, from which molds are filled in yard; (5) mold set up for reinforced concrete grill for gable ends; (6) dormer sections cast in special wood molds; (7) foundations being set; (8) lifting a floor slab; (9 and 10) lifting wall section from truck; (11) attic level—dormers and chimney tops (see also Fig. 12).



Figs. 12-19—Large Unit Built Houses—Further Details that May Be Clearly Understood from Previous Illustrations

Building Concrete Industrial Houses by Harms System in France[1]

By Henry J. Harms, Jr.
Paris, France

The authors' first houses were built:

1. To prove beyond a doubt the possibility to pour or cast a complete house in one continuous operation.
2. To obtain the necessary data for the calculation of costs. As a matter of fact, the unknown factors were:

(a). The number of hours necessary for the construction of houses, using our methods.

(b). Average price of labor.

(c). Number of hours necessary for the touching up and finishing, after the pouring.

All other items entering in the calculation of the costs are the same as for ordinary construction.

Each item is treated separately, in the order given, and for simplicity will refer to the house as illustrated and of which 19 were built at Salindres.

The houses described do not, it is admitted, take full advantage of the asthetic possibilities that lie in concrete industrial houses, but the designs were furnished by our clients, who might have secured even better results at no increase in cost.

The work is done with the Harms-Small system of metal forms, consisting of cast iron plates in unit sizes. The progress of work by this system has been recorded by Concrete in comprehensive articles,[2] the first of which described the pouring of an all-concrete house at Santpoort, Holland, in May, 1911. This four-room, two-story house, with the exception of pre-cast floor and stair units, which were set in place in the forms, was poured complete in a single operation. This is the first known instance of a concrete house placed complete, in a single pouring. The success of this experimental work led to the construction of several hundred houses.

What Has Been Done

After the first house in Santpoort, Holland (1911), the second house, in La Plaine, St. Denis, France, 1912, followed by some other small applications, which we consider as experiments and a training school, the following works were executed:

At Salindres,[3] Gard, 57 houses, forming 114 dwellings, with the same number of little sheds, and concrete enclosing walls, the whole forming a workman's city for the Cie des Produits Chimiques d'Alais et de Cammargue. In July, 1914, when war broke out, this first industrial application of the H-S system was nearing its successful completion. The war interrupted the work, but only a year later work was started again, with an entirely new crew.

At Lille, France, 228 dwellings, grouped 6 by 6, in two-story houses, for Crepy and Fils, textile industry. Work started in May, 1914, and on the outbreak of the war stopped. All material (250 tons of molds, mixers, derricks, etc.) was lost, of course. Although greatly handicapped by this loss of one-third of its plant and by the difficulties created by war, the company kept working as well as it could with the rest of the plant; the Salindres job was at last finished in 1916, and since then we have constructed:

At Basses-Indres[5] (Loire-Infereiure) 22 houses, 52 dwellings, for the Cie des Forges de Basses-Indres, entirely finished.

At St. Auban[6] (Basses-Alpes) about 60 houses, forming about 200 dwellings for the Cie des Produits Chimiques d'Alais et de Camargues. A repeat order. Is being finished at this time.

Two small jobs of about 20 houses each for the Cie de St. Gobain. Now in course of construction.

[In order that Mr. Harms' work, as he describes it in detail in succeeding issues, may be fully understood, the former article in this magazine referred to is quoted liberally, since it described the essential features of the forms.

Cast iron segmental plates are erected for an inner and outer wall. Taper bolts are used which not only hold the wall together, but act as spacers to keep the molds at a uniform distance. The bolts are also used to hold the reinforcing in place until the concrete is cast. The bolt holes left when the centering is dismantled are filled with concrete. The largest unit used is 16" x 32", and weighs 75 lbs.

Reinforcing steel is placed and wired to the tapered bolts going through the plates. It is of interest to note that the bolt holes are in the center of the plate sections. The mechanic adjusts the cast-iron plates, using a pry equipped with a sliding hook. The scaffolding on which he works is supported by

[1]From articles in Concrete, Jan., Feb., and Mar., 1918.
[2]*Cement Age*, Feb., 1912, p. 68, and Concrete, May, 1918.
[3]31 miles north of Nimes, in Southeast France.
[4]Near Nantes, on River Loire, North France.
[5]Northeast of Marseilles, in Southeast France.
[6]Concrete, May, 1913, p. 209.

Fig. 1—Part of a Concrete Town Just Completed at Salindres, France
A similar group at Lille (228 dwellings) was lost with the contractor's equipment in the great German drive of 1914.

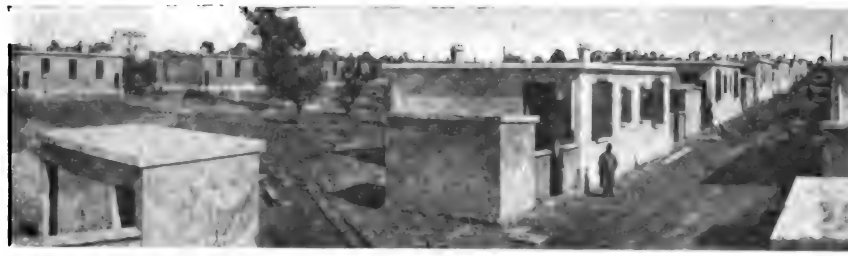


FIG. 2 — SINGLE STORY EMPLOYEES' HOUSES, SALINDRES, FRANCE

Each building is poured at a single operation in cast-iron forms. Note the industrial railway track for handling materials, and the complete absence of construction rubbish.

brackets attached to the cast-iron plates. The inner surface of the plates is well oiled.

The floor and roof slabs, window and door frames and any steps are of pre-cast concrete and are placed in connection with the molds at the time of their erection. By thus making floor and roof slabs and the steps in advance and placing them as erection proceeds, no extra molds are necessary. The forms may be removed very shortly after the concrete is cast, since no shoring or centering is required under the pre-cast floors.

After the pre-cast roof slabs are in place the structure is ready to pour. A hopper is erected on a scaffold above the roof level and concrete mixed in an American-made batch mixer is hoisted in a bucket and dumped into this hopper.

CONSTRUCTION TIME

While building the experimental houses at Santpoort and St. Denis, we had the time kept very carefully. From the figures thus obtained studies were made and a *time co-efficient* established, which we were reasonably sure would hold in industrial applications.

The time co-efficient represents the number of hours of labor per sq. meter of wall and partition surface necessary for the rough work, only one side of each wall and partition being counted and openings NOT deducted.

By rough work is understood: erection of molds, pouring, dismantling, transportation of molds from house to house, moving the mixer, cranes, etc., filling holes left by spacer bolts, eventual touching up, washing of interior walls with thin cement grout or water, placing of window sills, pouring joints of floor beams and jointing up underneath, preparing floors to receive tiles or other flooring; in other words, nothing is left to be done but painting, or papering, interior walls, placing of roof covering, hanging of doors and windows, painting woodwork, placing roof covering, plumbing, etc.

The co-efficient for the Santpoort and St. Denis houses proved to be 17.05. On the second house at St. Denis, a large, 24-room house (12 families), we obtained 16.82, and for 4 houses built at Caen (each four rooms), the co-efficients were 14.44, 11.16, 9.0 and 8.0.

TIME STUDIES ON 19 HOUSES AT SALINDRES

The results obtained at Salindres, the first industrial application, follow. Our estimates per house were:

FIG. 5 — FORMS IN PLACE, READY TO POUR A HOUSE

Each plate is bolted through the wall at its middle. A special crane handles the concrete in buckets

	Days	Number of Men	Total Hours
Erection	8	13	1,150
Pouring	3	8	250
Dismantling	8	7	600
Finishing	8	6	520
			2,520

The actual average time for 55 houses as taken from time sheets shows:

	Total Hours	Partial Coefficient
Erection	1,061	2.72
Pouring	239	.613
Dismantling	269	.69
Finishing	334	.855
Total	1,903	4.88

(Total wall surface, 390 sq. meters.)

While we had calculated with a co-efficient of 6½, the co-fficient obtained proves to be 4.88. We find therefore that in calculating time with a co-efficient of 5½ hours per sq. m. one has a safe margin of over 10%.

THE FORMS

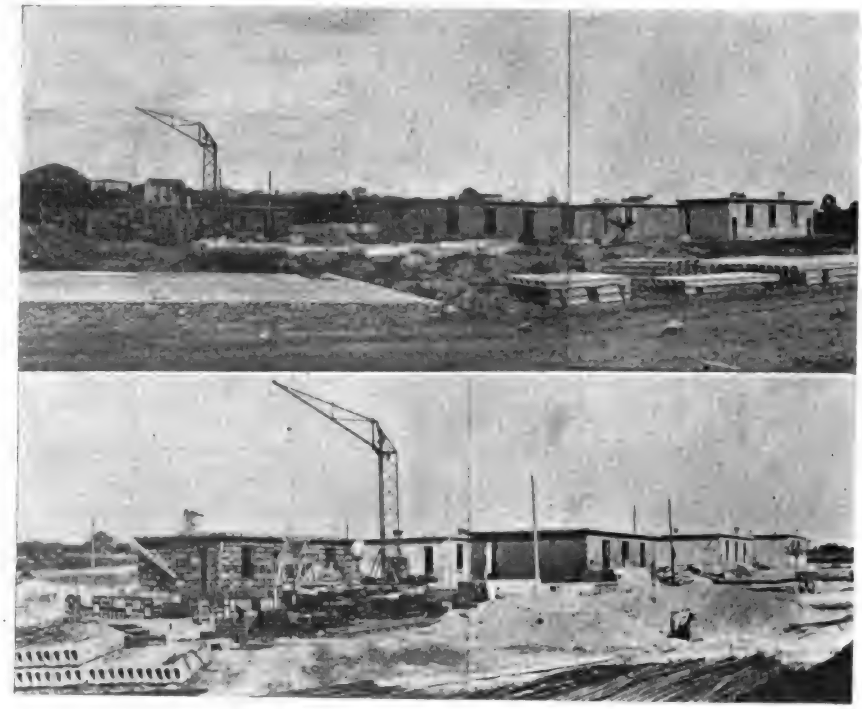
We abandoned the use of steel for forms in favor of cast iron for the following reasons: (1) Pressed steel molds have rounded corners, which leave hindersome marks; (2) assembled steel molds are very expensive; (3) steel and wood combinations we found impractical, short lived and expensive; (4) steel rusts much easier than cast iron; (5) unless made very heavy, steel molds are much less rigid than cast iron, and require a greater number of stay bolts, leaving a greater number of holes to be filled after dismantling (with cast iron molds stay bolts are spaced 80 to 120 c. m. horizontally 2′ 7½″ to 3′ 11¼″—and 40 cm. 1′ 3¾″ vertically).

On the other hand, molds of cast iron, the flanges of which are finished, have none of these faults. They are rigid and practically water-tight, are exact to measure, cheaper than steel, since all holes can be cored; they rust less easily; they leave a smooth surface, as is illustrated by the following experience:

Our work at Salindres was completely abandoned in July, 1914, all the workmen being called under arms. A house had just been poured; another one was being dismantled; a third one nearly completely erected. After about 12 months, and after passing through a severe winter with much snow and rain, work was continued. To our great surprise we found that practically no damage had been caused by rust, not even on the first two houses, where the molds had all this time been in contact with the concrete.

All shapes are easily made of cast iron without adding much to the cost, while with steel molds special shapes for cornices, etc. (must be made of wood).

Our largest molds measure 45 x 80 c. m. (about 18″ by 32″), and weigh about 38 kms. (80 lbs.). The smallest plate measures 15 x 15 cm. (6″ x 6″), and between these two we have all intermediate sizes, with intervals in each dimension of 5 cm. Further, we use inside corner molds of heights corresponding to the various heights of the molds and making corners of 10 x 20 or



FIGS. 4 AND 5—CONCRETE HOUSES UNDER CONSTRUCTION AT SALINDRES, FRANCE

Views were taken exactly one week apart, and show progress of two houses in that week. This was during the fourth week after actual building began on the Salindres job.

1 x 15 cms. We have also inside and outside cornice molds, with their inside and outside corner plates, all 25 cm. high.

We use steel only for the plates closing door and window openings (Fig. 6), and for the molds forming the hollow space under windows for the sills, which are cast in place after dismantling, using wooden or steel molds.

In our calculations for this work we had estimated that after each pouring the molds would have to be cleaned and oiled, just as on the previous small jobs. Practice proved that the only molds that needed cleaning were those that are accidentally soiled. Otherwise, the inner surface is clean and the molds can be used for the next house immediately. Oiling is necessary only every third or fourth pouring.

THE CONCRETE

The concrete was a special, easily flowing, homogeneous mix and was described in a previous article in CONCRETE as follows:

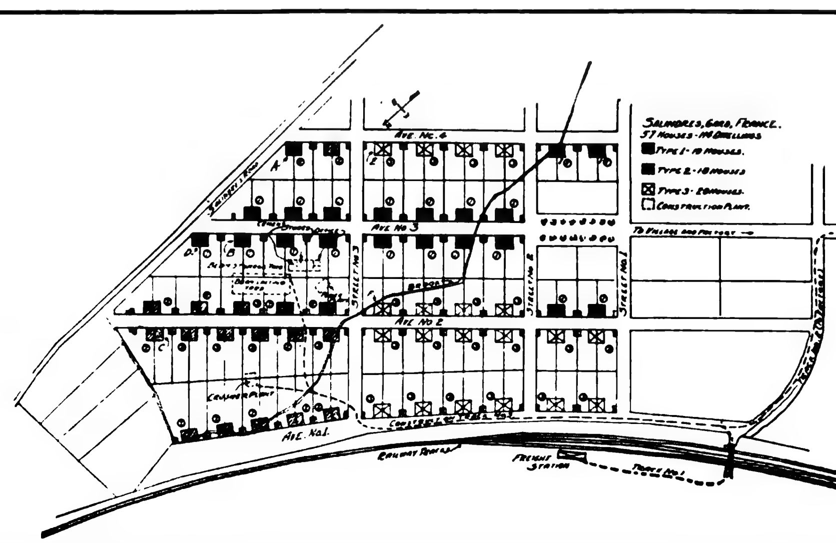
An essential is that the concrete itself shall flow very readily. To the usual concrete mix, 1:2:3, using stone or gravel, a certain quantity of clay is added by dissolving it in the water used for gauging the concrete. The clay so used is the definite factor, as the addition of it to the water is governed by means of the hydrometer. It is this addition of the clay that allows the concrete to be of such composition that it is very fluid and at the same time remains homogeneous and very dense. The addition of the clay contributes to the density of the concrete, for it fills the voids in the cement in a manner almost parallel to the way in which the cement fills the voids in the sand and stone.

While this mixture is richer than is ordinarily used, it is worth while, for it has been found that the concrete produced is impervious to water. From tests made at a French laboratory, by H. Mesnager, chief engineer of bridges and public works, France, this concrete gave very satisfactory results in both compression and adhesion. It crushed at the age of 7 days at 75 kg. per sq. cm. (1.065 lbs. per sq. in.). This is equivalent to requirements in Paris for soft building stone.

BUILDING METHODS ON THE SALINDRES GROUP

The Salindres group consists of 57 houses, each house forming two dwellings, entirely independent of each other, each having its own entrance, garden, cellar, out-

FIG. 6—MAP OF THE GROUP OF CONCRETE HOUSES AT SALINDRES



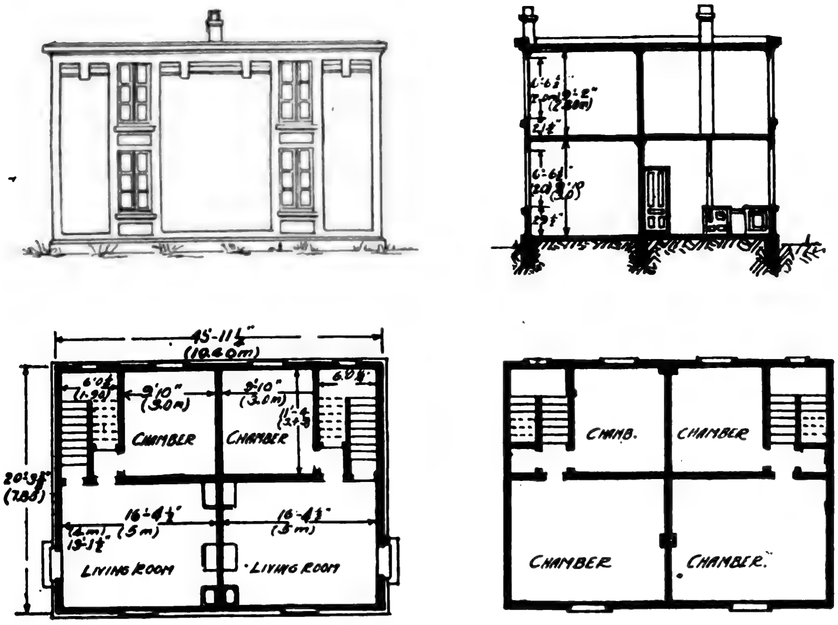


FIG. 7—PLANS OF TYPE 1 HOUSE, SALINDRES

This is the house on which data to be given are particularly based.

house with toilet, etc. Three different types of houses were built, viz.:

19 Type 1—8-room houses, two 4-room apartments (Fig. 7).

18 Type 2—5-room houses, one 3 and one 2-room apartment.

20 Type 3—5-room houses, one 2 and one 3-room apartment (Fig. 8).

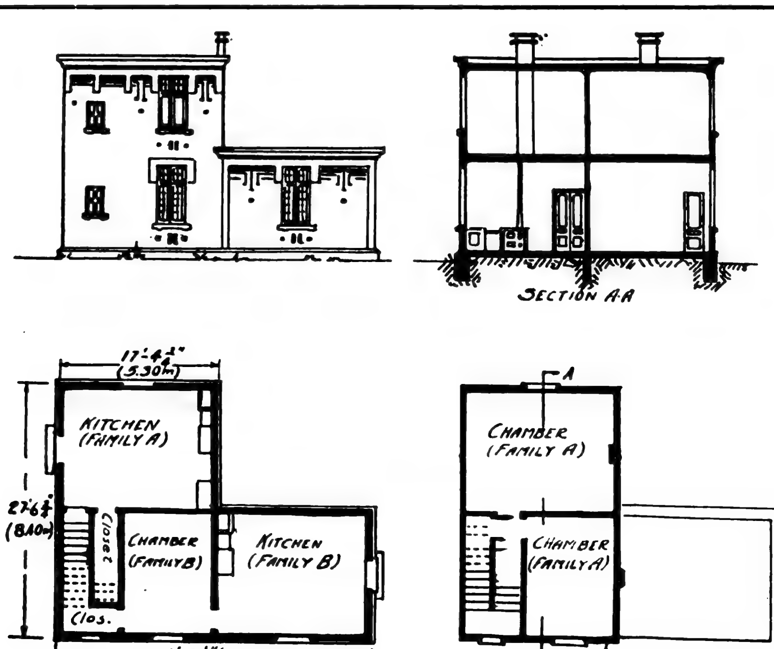
The general layout is clearly shown on the plan (Fig. 6), which also shows clearly the location of the workmen-city with regards to the factory and the village. The lowest part of the ground follows roughly the little brook, traversing the plot diagonally. From the brook toward the village the ground runs about level, also on the other side of the brook, between Avenues 1 and 2. Above Avenue 2 the ground slopes rapidly toward the road shown.

We located the power plant, office, storehouses, etc., on the high spot, as indicated; the power plant, independent of the other buildings, consisted of a 20 h. p. locomobile, driving a 25 h. p. dynamo, this being ample to furnish power for the large concrete mixer, traveling derrick, stone crusher and some little auxiliary machinery. The blacksmith shop was located between the office and the power house, and the floor beams were fabricated and stored where shown (Fig. 6).

Our intentions were to start with house A and work down Avenue 4, move to house B, and work down Avenue 3, etc., all the time working down and toward the freight station, the point where our plant and material arrived and from which it later had to leave. Unhappily the foundry did not furnish the molds as quickly as promised, and after house A had been poured we had to jump to Avenue 2, house C., having enough molds to build Type 2 houses but lacked some for the other types. On reaching Street 3 we had received enough molds to build all the types of houses, and since client desired very much to have the houses in main street, Avenue 3, finished as quickly as possible, we again moved and started in Avenue 3 with house D. We then followed

FIG. 8—PLANS OF TYPE 3 HOUSE, SALINDRES

The decorations suggested by the illustration were designed to be painted on.



our program, working down this avenue until finished, skipping to Avenue 4, house E, and working downward. Then we moved to Avenue 2, house 26, and when this was finished started Avenue 1, house F.

We had also originally intended to pour the outhouses and garden walls, with which each block is surrounded, at the same time as the houses, but lack of molds prevented us from doing so, and this work was executed separately, using a Smith mixer,[8] electrically driven. No crane was used to hoist the concrete; the outhouses were only about 7′ high and the concrete was poured with buckets handed to a man standing on a scaffold.

Total area of building site is 11 acres.

As stated, all the plant, etc., arrived at the freight station shown on the plan, from which we had laid portable tracks, as shown, track 1 having a steep grade. (French railroad regulation prevented us from discharging across the tracks.) We received our stone from the factory over track No. 2, from a quarry in the neighborhood supplying gas ovens; they sent us all the undersized stone (below (2½″). We crushed it to 1″, using the crusher run and adding necessary river sand. We generally added gravel, because the quarry did not supply us fast enough with the necessary stone.

We had planned to work with 4 sets of molds and 3 gangs, each with 14 erectors, each set of molds to be so composed as to enable us to construct any one of the three types of houses. According to our estimates, we would build with this organization seven houses per month.

On account of difficulties in securing men, we were never able to have more than one gang of erectors; nevertheless, we have had months in which eight houses have been poured.

Experience taught us that for houses of this kind (ground area not exceeding 1,000 sq. ft.), the number of men in the erector's gang should not exceed 24, who will erect molds in less than 4 days.

The work should be organized in such a manner that the various gangs follow each other regularly, the whole schedule being based on the speed of erection, starting with the cellar diggers, foundation builders, etc., each gang doing but one special kind of work, as much as possible on a bonus or piece work system.

Our superintendent at Salindres, an Italian, intelligent and capable, grasped the spirit of orders given and was able to have them executed.

It may interest contractors to know the make-up of our different gangs:

Erection Gang—1 gang boss, 6 erectors, 8 helpers.

Pouring Gang—1 derrick man, 1 mixer man, 1 gang boss on roof, 9 men.

Dismantling Gang—2 dismantlers, 2 helpers.

As stated before, the time indicated for the erection comprehends: Normal transport of molds, representing at Salindres on an average 7% of the erection time (70 hours for house Type 1).

The time indicated for pouring includes normal transport of mixer, derrick, etc. Also placing the floor beams and placing of shores under beams (left in place for 4 days), necessary cleaning of machinery.

Abnormal transport of molds and machinery—Certain allowance for abnormal moves must be made. At Salindres we had 5 general displacements of 200, 165, 165, 220 and 330 yds. As the ground was not brought to grade, moving of derrick and mixer molds was difficult, took more time and cost more money than if the ground had been properly prepared. The average time of these moves was: Molds (200 tons), 500 hours; machines, 175 hours.

Fig. 9—Molds of Window (Door in Background), Showing Steel Plates for Closing Opening Between Molds

Fig. 10—Cored Space Under Window, with Mold Lying on the Window

Fig. 11—Liquid Concrete from Mixer Filling the Buckets

Fig. 12—Dumping the Bucket on Roof Over a Partition Opening

Fig. 13—The Position of Crane and Mixer in the Center of the Street to Pour Two Houses from One Position

Fig. 14—Avenue 3, Looking Uphill

Laying concrete gutters and sidewalk.

Plant and Machinery

Various improvements have been made on the molds, but the war prevented the ordering of new material. These improvements will increase the speed, which will also be increased by having 2 or 3 erecting gangs working simultaneously. Even without a premium for record time, the gangs would race against each other.

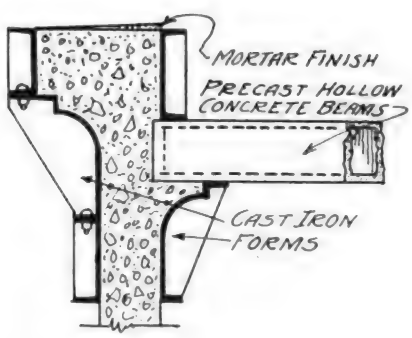


Fig. 15—Detail of Roof Construction

Our machinery at Salindres consisted of a large traveling derrick of 1,000 kilos (2,204 lbs.) capacity; height to foot of boom, 40′; reach of boom, 26′, turning through 270°. The great capacity of the crane permitted us to hoist 11 cu. ft. buckets at a speed of 80′ per min. These buckets were of the V type, and two buckets were used, one being filled while the other went up.

We started work with a mixer, supposed to be of 18′ capacity, dry materials, but later poured even the large houses with two and sometimes only one electrically driven Smith No. 00[3], with special outer blades. To the mixer we had adapted an easily removable door, permitting us to get 6 to 7 cu. ft. per batch of perfectly mixed concrete.

We deem it unnecessary to describe the pouring methods used on the first small jobs. Our installations worked well, but would have been costly and not practical for large work.

For the Salindres job we had asked bids for a transportable chuting plant, installed on a flat car. This machinery, being entirely unknown in this country, the price was so great we fortunately abandoned the idea, and later experience taught us that the proposed plant would have been uneconomical. We had at that time the idea that large mixers should be used, but found out that it is far more practical on this class of work to use small size mixers, easily portable.

The most practical equipment on a good sized job will be a portable chuting plant, installed on a flat car, using a 40′ tower with quick-shift boom plant, first chute and second counterweight chute, each 30′ long; a 12′ bucket installed on the car, an 11 cu. ft. mixer with loading hopper descending to ground. Further, half a dozen light, portable derricks, (similar to Sasgen steel derricks), arranged for power hoisting by portable electric or gasoline hoists, for placing floor beams, hoisting roofing material, etc.

The transportation of the chuting plant will be much easier than it would with such a derrick as was used at Salindres, since by the quick shift arrangement the boom and chute can be lowered, after detaching the counterweight chute, if necessary.

No special plant was used for the transportation of the molds from house to house. While dismantling, the molds were sent down with block and tackle, the block fastened to a counterweighted plank on the roof, or wherever possible by simply sliding the molds down on inclined planks, with some straw at the bottom, transportation being done by wheelbarrows or little flat cars. Considerable time could be saved by using gravity conveyors.

On important work these gravity conveyors could be advantageously used for unloading and loading plant and material from cars, reducing labor to a minimum.

Floor Beams

The principle of our system was to pour all of the houses in one single pouring, including, therefore, floors, roofs, steps, etc., and while absolutely possible, the pouring of floors, roof, etc., offered the following difficulties:

a. Practical Difficulty—To pour the floors it would be necessary to use molds underneath and above. The erection of these molds necessarily would be slow and they would require a very solid shoring.

b. Economical Difficulty—The dismantling of the floors could not be done at the same time as the walls. The undermolds would have to be left in place for at least 14 days, while the wall molds are regularly taken off after 36 to 48 hours. A great number of molds would therefore be idle, requiring a great number of extra sets of floor molds.

This would be poor utilization of the molds, and we therefore soon abandoned the idea of pouring floors and roof and used on our first house pre-cast floor slabs. We now use hollow beams, the form of which I invented. Hollow steps are fabricated in a similar way and floor beams and steps are erected at the same time and with the walls. On pouring the walls, the supports for the beams and steps are poured at the same time. The beams, are 40 cm. (1′ 3¾″) wide, 15 cm. (6″) thick, the hollow being 11 cm. (4⅜″). The shape of the side of the beam is such that it touches at the bottom and leaves a space at the top for filling joints. Once the joints are filled, the filler forms a perfect key and all the beams practically form one slab. The beams rest on the inside cornice or cove (protruding 8 cm.—3 5/32″) and extend 2½ cm. (1″) in the walls, also bearing on the solid wall.

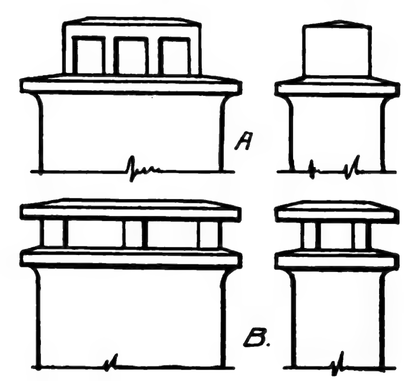


Fig. 16—Chimney Tops

Flat Roofs

The general roof construction was as shown in Fig. 15. I am an advocate of absolutely flat roofs when using composition roofing of the rubberoid type, but the French architects insist on a certain slope, which we made by placing on the flat roof beams a sloping covering, made of poor concrete, pitch 1:10.

Flat roofs have the disadvantage in hot climates that the upper stories are rather warm on hot days. We remedied this by using our hollow roof beams to create a forced ventilation.

We further noticed that the roofs as constructed at Salindres caused cracks in some of the walls, opening and closing with the sun. It was only after long re-

search that we discovered that it was the roof that was the cause, by the expansion of the beams, which actually pushed the walls apart. We reinforced the walls by a diagonal reinforcement against these stresses, and had no further difficulties. It might have been sufficient to replace the solid connection between floor beams and walls by a flexible joint of some elastic filler, but we were afraid that these joints might later cause infiltrations of rainwater, especially in the hot climate of southern France. We had not noticed this defect on houses built around Paris, although the same roof construction was used.

General Finish

At Salindres all the finish floors were of tile, laid in cement, as is generally used in this part of France. The walls were painted with an ordinary water paint in two colors; light for the walls proper, and dark brown for the washboards. Electric light, running water (each house having its own meters), were provided. Houses on low ground were without cellars, and for those the outhouses in the garden were built somewhat larger. These outhouses, one for each family, contain the water closet, separated from the storage part of the outhouse by concrete walls. As Salindres did not have a sewer system, the group was provided with an independent sanitary system, consisting of concrete cesspools for every two families, and each cesspool was connected to a Porsain concrete filter system.

All rooms have a ventilating hole in the ceiling, communicating directly with independent conduits leading to the roof. These holes can therefore be used as chimneys.

Chimney Tops—As already explained, the chimneys above the roof were poured in regular molds and the tops with special molds, having molds for tops for 1, 2 or 3 hole chimneys (Fig. 16*a*). The tops (Fig. 16*b*), as constructed for Basses-Indres, proved more satisfactory.

As to the general aspect, we can truthfully say that the houses are very pleasing. All visitors of our works were agreeably surprised. American readers should not forget that concrete is still in its infancy in Europe, as compared with America.

Labor for Touching Up and Finishing

In our calculations for the bids we had taken into consideration that the walls would be very smooth on dismantling, but the results far surpassed our expectations, as will be easily seen on examining the data just given, which show that time spent was about 36% lower than estimated.

The surfaces, as left by the molds, are so smooth that it is sufficient to wash the walls down with a thin cement grout to obliterate any marks. If done while dismantling, before the surface has had time to harden, plain water does the trick if applied with an ordinary soft brush. This operation is superfluous if the walls are to be papered afterwards. The floor beams are even and smooth underneath, and it suffices to apply a thin finishing coat of plaster to obtain a smooth, neat and white ceiling.

Under finishing is included touching up, filling of holes left by stay bolts, washing down of interior walls, casting of window sills (cast in place with special molds of steel or wood), leveling off of cornice and applying a neat-cement coat on it, pouring beam joints and pointing up underneath, preparation of floors for flooring by leveling them with a thin layer of cinder concrete.

Construction and placing of chimneys above roof and chimney tops are not included. The chimneys were first cast in place on the roof, using regular molds for the centering, but afterwards we cast the chimneys on the ground, in ordinary molds and placed them on the roof ready made. The chimney tops were also poured on the ground in special wooden molds. All this work was done under the piece-work system, by one man and his helper, paying him a definite amount per chimney top and per flue.

[Editor's Note.—The costs as given by Mr. Harms were stated in francs, and all measurements were metric. For the convenience of readers they have been transposed to English equivalents. Since the costs given can be used for comparisons only, and since exchange values are not stable, the dollar has been taken as equal to 5 francs. This may result in some slight apparent discrepancies in the figures, which did not exist in Mr. Harms' manuscript.]

How Floors Were Built

Walls—Hollow precast beams for floors and roofs were cast in molds designed by the writer, made partly of rolled steel, partly pressed steel and partly cast iron. The price of each unit was in 1912-1914 $2.10.

The experience at Salindres proved that the output per unit easily represents 23½ sq. ft. of floor beams per day, or 65,167 sq. ft. per year.

It was demonstrated that a typical plant could build 120 houses per plant year. Allowing each house about 1,800 sq. ft. of floor beams, a total of 40 units are required, representing $8,000.00. Amortising this in ten years, the molds represent a charge of about a half cent per sq. ft. of beam cast.

Cost of Beams—At first beam casting was done as time work, paying the men a certain bonus for production above standard. Later the men preferred piece work, accepting .031 cents per sq. ft. for all labor, including bending rods, moving beams to storage yard, etc. The cost of the beams in 1914, including amortization, was slightly over 9 cents per sq. ft. The only cheaper floor is built of cheap planking, nailed on thin joists, with no ceiling underneath.

Cast Iron Molds

The disadvantage of cast iron molds is that they must be made in large quantities to be economical. Our company placed in 1912 an order for 1,400 tons of molds, of about 80 different patterns. This order permitted the foundry to organize for series work and machine molding. Bronze patterns were made, which were accurately finished, permitting minimum allowances for finishing. The foundry made a splendid job of it, the outer surface of the molds, which was to come in contact with the concrete, was left unmachined; was smooth and true; accurate molding permitted finishing the flanges in one single unit. No special machinery for finishing was installed.

When war broke out about 650 tons of molds had been delivered, about 200 tons more had been cast and were waiting at the foundry to be finished. The foundry being at Maubeuge, occupied by the Germans since August, 1914, all material not delivered was lost, also drawings, patterns, etc.

Breakage—To make proper allowance for breakage, we believed the molds should be amortised in ten years at the most. Our fears were not realized; the breakage on the first job, with all the drawbacks of a new organization, was less than ½ of 1% in the first year. Breakage will be still lower in future. Very few molds were really broken on the job or in transportation. Most breakage on the job was caused by the use of pries for the adjustment of the plates; all those breaks occurring

at the long holes in the flanges. We have changed the design of the holes. Sample plates were cast in June, 1914, and it was found impossible to break the plate at the point, even when using excessively long pries and applying abnormal forces.

Cast iron molds are not heavier—in fact, are lighter than steel for a given rigidity. Much has been said against the use of metal molds on account of their weight. We never have claimed our molds can be used advantageously for building a small number of houses.

Cost of Molds—Our first order was filled at an average price of $68 per ton. In 1914 we asked prices for another big order at the same foundry. Price at that time was $77 at the foundry, which found its first price had been too low. Time studies, undertaken with expert machinists, proved that a finishing shop would pay for itself with the first 1,000 or 1,200 tons of molds. Special milling machines would be used with long benches, to take the widest plates and mill both sides at once, with very little planer work. The total cost, taking in consideration the amortization of the finishing installation on the first 1,200 tons of molds, would be about $60.00 per ton of molds.

Construction Cost Keeping Methods

The construction timekeeper kept the regular time book, copies of which were sent, with payroll, to the head office twice each month. Further, he noted on special sheets the work at which each man was occupied during each day—one sheet per day.

Cost of Labor

We had hoped that unskilled labor could be used, but the experience gained with the first applications on a small scale was not very encouraging. In fact, the average price paid for the labor, as calculated from the time sheets and payroll, was as follows:

First house at St. Denis: $0.18, or 28% higher than local price for common labor.

Large St. Denis house: $0.22, or 47% higher than local price. We experienced on this job great difficulties with workmen: bad will, strikes, etc.

Houses at Caen: $0.15, being 50% higher than local price. On this job we had great difficulties with the men on account of large works being executed in the direct neighborhood by a steel plant under its own management. Being pressed, high wages were paid, and we had to follow suit, or lose the few men we could get hold of. Further troubles were caused by drink and an incompetent foreman.

At Salindres we had better fortune:

Total of payroll	$6,164.08
Bonus	581.88
Insurance, 6%	404.55
Total paid	$7,150.51

Total number of hours as shown by the time sheets, 72,697.
Average price, $0.098 per hour.

This figure is only 3% higher than the local price for ordinary unskilled labor, which was at that time at Salindres $0.095 per hour.

In the hours and average labor price the following are not included: Superintendent and his assistant, timekeeper, engineer, etc. These are taken care of under the item: general expenses.

For estimates and bids, the labor price should be taken 15% higher than local price for common labor, thereby leaving more than 10% for contingencies.

At Salindres we used mostly Italian labor. None of these men had ever before done similar work. The first house was erected under the personal direction of the writer, assisted by an assistant engineer, who had actually worked previous jobs. Our superintendent and his assistants did actual labor on this first house, to become familiar with conditions. Ordinary unskilled laborers made excellent erectors in a few days.

The Task and Bonus System

After pouring the first two houses we started the erection under a bonus system, paying double time for all hours saved on a certain limit time, which limit was fixed by a committee consisting of the writer, his engineer, the superintendent and the gang boss. The results were surprising, and after some time the system was changed, paying only simple time for the time saved.

As a general rule we had the work done, whenever possible, under a bonus or piece work system. Both worked out to entire satisfaction of ourselves and the workmen.

We also paid the erectors and dismantlers one hour extra per day, since their work was dirty and quite hard. This avoided raising the standard local labor price per hour. Night work was paid double and from time to time bonuses were accorded. These supplementary hours and bonuses are all included in the cost tables.

Typical Job Costs

The data secured on a typical job will be given in hours, which will enable an estimate of costs to be made for any locality.

Molds—We assume the use of 300 tons of molds, with which 120 houses per year, counting 240 working days, can be built.

Since during the first year the breakage of molds at Salindres was less than ½ of 1%, we can safely amortise the molds in 30 years.

The molds cost $68.00 per ton; scrap was sold for $12. We must then amortise $56.00 per ton of molds in 30 years, or, for 300 tons, $660.00. The plant should consist of: One 11′ mixer and one 4′ mixer, with chuting plant or traveling derrick, storage sheds, portable track, small plant, etc. Total, say, $7,200.00. Amortising in three years, cost per year is $2,400.00.

General Expenses as Paid at Salindres

Supt., per year	$ 720.00
Asst. Supt., per year	600.00
Timekeeper, per year	480.00
Engineer, per year	480.00
Repairs of machines	100.00
Oil and grease for molds, etc.	600.00
Small supplies for office	200.00
Coal, gasoline, kerosene, etc.	600.00
Sundries	420.00
Total	$4,200.00

Installation

a. Unloading and loading 320 tons of molds and small plant (allow 5 tons per man per day of 10 hours and a total of 640 hours at 18c)	$ 84.00
b. Unloading and installation of power plant and crusher—total 80 tons; 150 hours at 20c, 500 hours at 12c	90.00
c. Changing electric lines and abnormal moves of machinery—200 hours at 18c, 600 hours at 11c	102.00
d. Abnormal moves of molds, cleaning, etc.—1,500 hours at 10c	150.00
e. Dismantling and loading of machinery—100 hours at 20c, 400 hours at 12c	68.00
f. Construction and dismantling sheds and shanties—100 hours at 20c, 200 hours at 10c	40.00
g. Placing and changing portable track—1,000 hours at 10c	100.00
Total	$634.00

Transportation of Plant

We assume that a job will only be charged with the transportation one way, the following job to support the charges for the other way. We further assume an average move of 155 miles, at an average cost of 12.8 cts. per ton mile, and a total of 350 tons, or 350 × 12.8, about $670.00.

FIG. 17—GENERAL VIEW OF BEAM YARD, SHOWING STAGES OF FABRICATION

Note storage of beams on side to prevent sagging. Part of stored beams with ends filled, at A. Also steps, at B. Also note that five men are fabricating an average of 300 sq. ft. of beams per day. One man and helper, not shown, are fabricating necessary reinforcing units.

RECAPITULATION

For purposes of estimate based on the foregoing costs, we can assume:

Amortization	$3,060.00
General expenses	4,000.00
Installation	800.00
Transports	700.00
Plans, estimates, etc.	2,400.00
Total	$10,960.00

Based on an output of 120 houses per year, this gives an overhead of approximately $92.00 per house. Profitable contracts have been taken and executed on a basis of $100.00 per house overhead.

OUTPUT OF MOLDS

According to the data obtained at Salindres, the maximum number of men per gang of erectors should be 24. The erection takes 1,600 hours, so such a gang will erect a house within 4 days.

To obtain the best output of the molds, work should be carried on with at least two gangs of erectors and with three and a half sets of molds. Since each set weighs 85 tons, the total would be 255 tons. With two gangs of erectors we would thus pour a house every second day. In a year of 240 working days, we should build 120 houses of about 100 sq. yds. of surface each and the output per year and per ton of molds is therefore about 47 sq. yds.

The men employed should be about as follows: 48 erectors, 12 dismantlers, 18 finishers, 12 pourers, 16 casting beams and steps, 24 building foundations, 10 employed on incidental jobs; total, 140, or, say 150 men.

COMPARISON OF CONSTRUCTION

Considering for the sake of comparison, workmen's houses of two stories, one ton of molds should build one house per year, and with four typical jobs, employing 1,200 tons of molds and 600 men, we would obtain 1,200 houses per year.

According to Senator Louis Marin, president of the Government Commission for the reconstruction of the devastated regions, French contractors figure for the construction time of an ordinary house with ordinary methods and working with 10 men, 5½ months.

According to those figures (remember that they were given by the contractors, not by us), 600 men would construct per year 130 houses. Note that we employ unskilled labor, while for other construction the 600 men would be for the greater part carpenters, masons and other *skilled* labor.

COMPARISON OF COST WITH OTHER CONSTRUCTION

Very exact costs were established before the war, with prices of material and labor then prevailing. Prices were figured for houses constructed of concrete as described, and at the same time from the same plans, prices were asked from well known architects and contractors for ordinary construction, without their knowledge that these bids would be used for comparison. Such investigations were made in various parts of France, as methods and materials vary a good deal. For instance, for the southern part of France the ordinary construction uses 18″ and thicker outer walls, built of poor limestone, laid in cement and lime mortar. Partitions are very poorly and cheaply made of plaster, applied on lath, and only for better houses on plaster or lime blocks. The outer walls are generally finished with a cement coat, but are not impermeable. For the northern part of France the ordinary construction for workmen's houses is with thin brick walls and block partitions. We found that a typical house (Fig. 4, p. 42, February, 1918, issue), cost $1,700 built of concrete. This price includes the $100 for amortization of plant, general expenses, as calculated.

The price of exactly the same house, constructed by ordinary methods and calculated as just explained, was in the most favorable case $2,400. We contracted the houses at $2,200, thereby giving client the benefit of an economy of 10% over ordinary methods and leaving for us a profit of $500 per house. The houses in question have an area of 883 sq. ft.; the profit .56 per sq. ft. of ground area.

We have made similar calculations for Holland and Belgium, and found that working 10% cheaper than with ordinary methods, we make about 25% profit under normal conditions. This is gross profit, and has to be diminished by general office expenses, administration expenses, etc., to arrive at net profit. On the last works undertaken during the war, the actual gross profit varies from 25% to 40%.

Wood construction might be cheaper, but is absolutely prohibited for dwellings in most European countries.

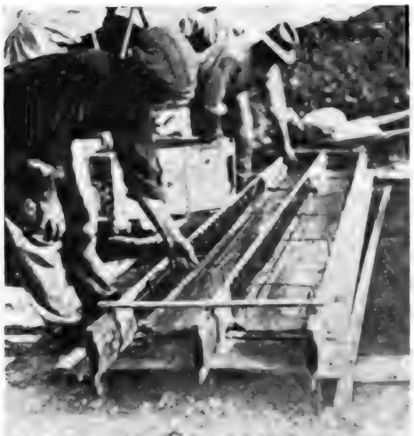


Fig. 18 — Placing First Layer of Concrete in Floor Beams.

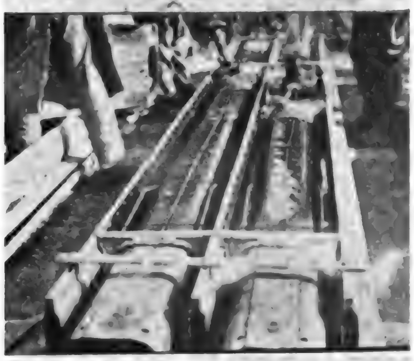


Fig. 19 — The Beam Cores in Place

Fig. 20 — Finishing Beams

What Experience Shows

Temperature—At Salindres, during two years, accurate thermometer records were kept under supervision of our client. Self-registering thermometers were used. One of these was placed on the roof of a house, open to all winds, but protected against rain and snow. The other was placed inside of the house, which was kept carefully closed. The numerous diagrams prove absolutely that: Concrete houses are cooler in summer and warmer in winter than ordinary houses with much thicker walls. The houses are easier and quicker to heat and hold the heat better.

Sonority—The houses are practically sound-proof, as well from inside to outside as from floor to floor and from room to room. The houses are more sonorous, that is, when hammering on floors or walls, especially in an empty house, more noise is produced than in brick, stone or wooden houses.

Permeability—The outside walls were not absolutely watertight at Salindres. Watertight walls might prob-

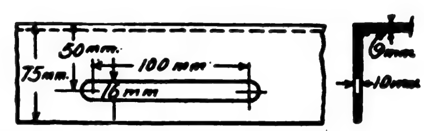


Fig. 23—Detail of Typical Form Plate

ably be obtained by using more cement or making thicker walls, but we overcame the difficulty in a cheaper way by using integral waterproofing compound.

What Others Say

Concrete is not yet so general a building material in Europe as in America. Concrete roads and sidewalks do not exist, and we are pioneers in concrete house building, therefore most of the people who visit our works, especially the architects, come with apprehension.

That their fears were not realized is evidenced by contracts awarded us and by numerous favorable reports written, as a result of their investigations.

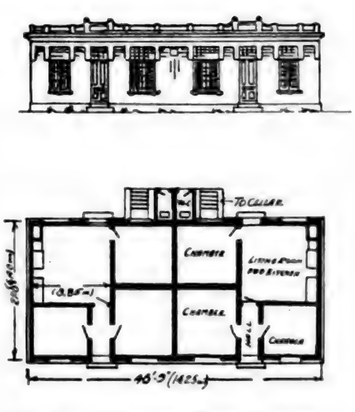


Fig. 21—Plan of Two-Family Houses Built at St. Auban, France

Fig. 22—Rear View of Houses at Salindres, France

Fig. 1—Ingersoll Type Houses at Phillipsburg

These pictures (from Concrete, January, 1920) show the finished appearance of the Ingersoll type monolithic concrete houses at Phillipsburg, N. J., built to sell with lot on which they stand for $3,250.

Ingersoll Type Houses at Phillipsburg and Union[1]

One of the most interesting industrial housing enterprises anywhere in this country is that which is under way at Phillipsburg, N. J., for the Ingersoll-Rand Co. The work is being done by the Phillipsburg Development Corp., under the immediate supervision of Paul R. Smith, landscape architect and town planner, as general manager. The development includes 25 6-room frame houses on concrete foundations, and 75 fireproof, all-concrete houses, being erected by the Ingersoll system, developed by C. H. Ingersoll and previously described in detail in this magazine.[2]

Twenty-five of the concrete houses are of the four-room, bath and basement type, from the same molds used on the work for Mr. Ingersoll at Union, near Elizabeth, N. J., previously described, while 50 of the concrete houses are to be from a new Ingersoll mold producing a 6-room and bath house.

Plans of all these houses and construction views are shown in the accompanying illustrations.

By the Ingersoll system no variation is permitted between houses cast in one set of molds. The basic idea with which Mr. Ingersoll started developing his system (whose engineering and building problems were worked out by Harvey Dodge, with many details of the application handled by Fred Fowler), is that of *manufacturing* houses as distinguished from their construction, producing in a group of houses a continuous repetition of certain sets of operations, permitting the greatest possible economy in erection of the structure in each individual case. In short, the idea is to apply in some measure to houses some of those manufacturing principles which have scored so successfully in making Ingersoll watches.

The first 25 houses at Phillipsburg for the Ingersoll-Rand Co. will be in the original four-room house molds. The next fifty houses of the concrete group will be from two or three sets of molds for six-room houses. These had not yet (December 18) been delivered on the job. There a possibility that the total number of concrete houses will be 100, 75 of them of the 6-room type.

The problem for the town planner at the outset was, therefore, so to group these identical houses as to escape the monotony of straight rows of like structures. How this is being done is indicated in Fig. 1, which reproduces a portion of the Phillipsburg development for the four-room houses, while the little pen sketches serve to bring out some of those inexpensive touches which are added in the completion of the structures to give variety and charm to the community. As shown by the sketches,

[1]From Concrete, Jan., 1919.
[2]Concrete, Aug., 1918, p. 42.

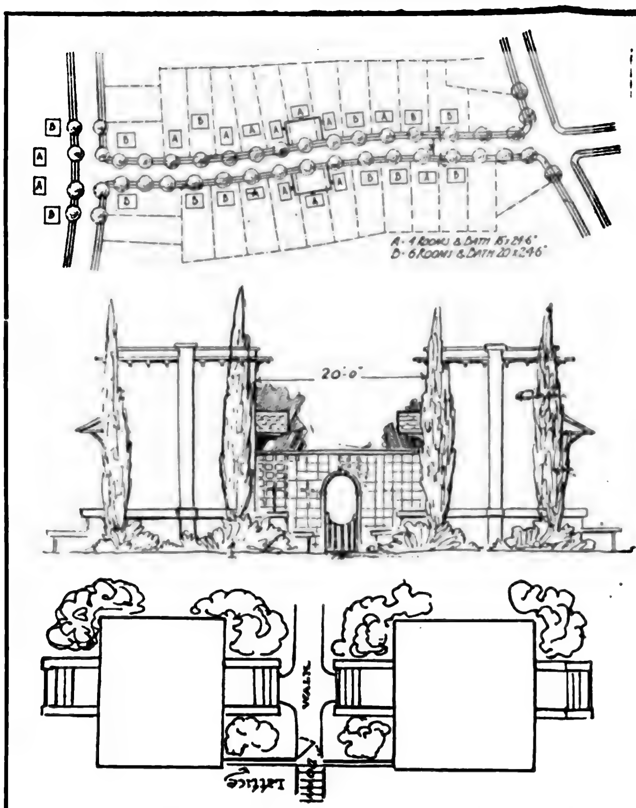


Fig. 2—Layout of a Part of Phillipsburg Housing Development, Showing Grouping, and a Rough Sketch to Show How Some Houses Will Be Grouped in Pairs and "Embellished"

this will be effected by connecting up pairs of houses by suitable planting of trees and shrubs, by pergolas and lattice-work, and by two or three different designs of entrance hoods. The site of the Phillipsburg work is beautiful topographically. Many of the houses are on a side hill, so that the rear entrance to the basement is at ground level. It has been decided to take advantage of this situation and to put a pergola over the door into the basement, giving access to the kitchen through the basement, rather than from a high flight of outside steps. Basement walls are 8" thick, and upper walls 6" thick.

The four-room houses are 16′ x 24′ in plan, with entry way, or hall, front and rear, two rooms and center stairway. Upstairs are two bedrooms and a well-equipped bathroom, besides two closets. In the kitchen are closets and cupboards, as shown by a detail. Exterior walls are painted inside with Ebonol waterproofing,[4] and then furred and covered with Bishopric lath[5], and plastered. The walls are finished with cement plaster, sand finish, and the beamed ceiling in white plaster. Wood floors are laid over the concrete on wood sleepers tasked to blocks set in the concrete when the floor was screeded. Exterior walls are being finished with a good thin coat of stucco, in some cases the finish being of white cement put on splatter dash, and in some cases gray cement with a float surface. The outside wood trim is painted green.

In the construction of the first six of the concrete houses (the stage of the operation on December 13), it had been possible to achieve a complete cycle so far as the concrete shell was concerned in less than six working days. A start to remove the forms from one house which had been previously cast, was made Monday morning, and at 10 o'clock Saturday morning the next house had been completely poured. That these operations may be clearly understood, a description of the use of the system is briefly summarized from the article appearing in the August number of Concrete, as follows:

The Ingersoll system is the nearest approach which has been made to the theory of house construction advanced eight or ten years ago by Thomas A. Edison. The outstanding difference is the fact that in the Ingersoll system no top form is used for the floors. The hydrostatic pressure of the concrete in the walls, the pouring being continuous for the complete structure, is disregarded. Advantage is taken of the fact that concrete of a proper consistency allowed a few minutes in which to congeal, ceases to flow even under considerable pressure later applied. Pouring is first done on one side of the house till the concrete flows to proper floor level and then pouring is done on the other side, returning later to the first position.

The wood forms are built out of 2" stock crossed at right angles with best grade ⅞" lumber, creosoted to preserve them and thoroughly painted. They are oiled before use and cleaned after use to such an extent as may be necessary and oiled where the surface requires it. The excavation is first made: 2" x 4" side rails are staked down; footings and floor placed in one piece. From this basement floor, vertical corner posts 6" x 6", are first set up on wedge blocks, the posts extending to a story height. These are held plumb and true by trusses made of 4 x 4's and ⅞" bridging. Adjustment to true lines is virtually automatic. All parts are carefully made and permit no variation greater than 1/16". The trusses are held to posts by iron bands made on each part and driven rigidly home by wedges. The form members proper, inside and outside, are supported by the trusses with bolts passing through from outside to inside with wooden washers for spacers, these being covered at each end by round iron washers strung on over the wooden washers to leave the round piece of wood well inside the wall when forms are removed. Outside forms are held further to line by horizontal 4" x 4" strings which may be seen in the illustration. The floor forms inside are also supported by the trusses, as also is the entire weight of the false structure and of the concrete as placed. Trusses carry the load to the 6" x 6" corner posts, ten of which are used in each story. The outer forms support brackets for staging, from which the upper forms are handled in erection and in stripping. The cornice and parapet forms are held by braces to outer forms, each piece having its precise location. In fact, every piece used has its unit number and a definite place in the erection scheme. Even with common labor, after a few operations, it has been possible to take a piece down from one house which has been poured, and set it in the proper position on the next house without rehandling. (At Phillipsburg a runway between two houses made this shifting very rapid.) When a certain stage of erection is reached the plumber and electrician are sent for and the conduits and pipes which are pre-fabricated are set in the walls with very few lost motions. Reinforcing rods and metal flue linings are then placed and nailing blocks are set. Blocks are placed ready to hand for embedding in floors when they are screeded. The concrete used is one part cement, two parts sand, and four parts cinders. The steel used is as follows: In each corner of building ½" rods; a ½" rod each side of each opening; ⅝" rod extending entirely around the

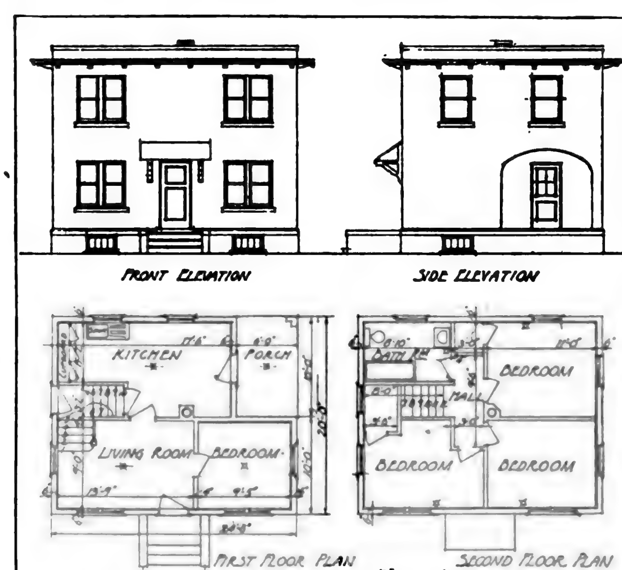


Fig. 3—Plans of Six-Room Concrete Houses

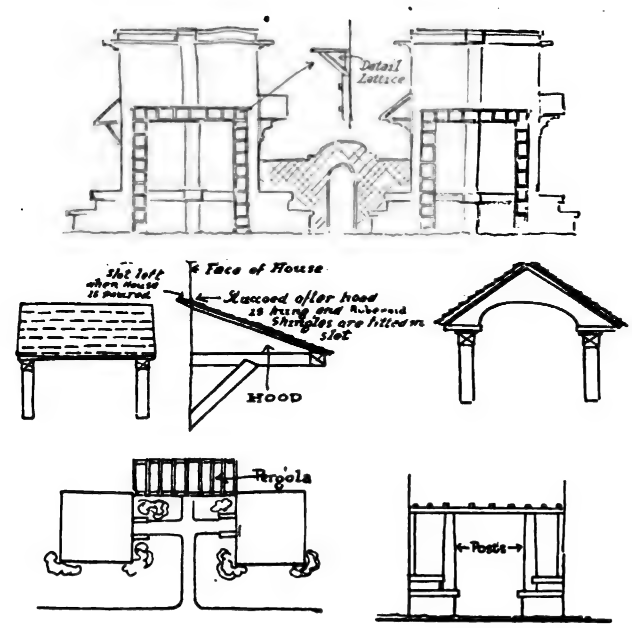


FIG. 4—FURTHER ROUGH SKETCHES TO SHOW EMBELLISHMENTS—LATTICE WORK, PERGOLAS AND ALTERNATE DESIGNS FOR ENTRANCE HOODS

building at each floor level with extra steel at door and window lintels. A complete house requires 1,000 lbs. of steel and 65 cu. yds. of concrete. All roughing for the plumbing and all conduits are embedded in the concrete.

In the erection of the forms the entire weight of the structure, both forms and concrete, is first placed on the corner posts, which in the four-room house are 10 in number. Yet these corner posts are first to come down when the forms are stripped. This is possible in view of the fact that the bolts passing through the walls and trusses, which support the forms, serve as a means of transferring the load to the concrete. As soon as a house is from 24 to 48 hours old under favorable weather conditions, the wedges are driven out, the corner posts are removed and set up for the next house in the operation. Trusses are then taken down and if the floor requires further support temporary shoring of about two 4 x 4's in each room are put in. The trusses are then removed and set up on the corner posts for the next operation. The form parts then come down in pieces as needed on the next job. The floor forms, which are usually the last to come down, are the last to be required to be set up on the next operation.

Mr. Ingersoll has made available for the use of CONCRETE a detailed cost sheet on the first twelve houses erected by his system at Union, near Elizabeth, N. J. The materials required are given in lump sum cost items, the same for each of the twelve houses. The labor cost is separately itemized for each of the twelve houses. The material cost per house, in the summer of 1918, was $997.36, while the labor cost averaged $965.66, making a total average cost for each of the first twelve houses of $1,963.02. It must be understood that this was an experimental operation, where the crew was being trained for the work. The precise material cost and the average labor cost are reproduced herewith. Consideration must be given to labor conditions with excessive turn-over and to the fact that it was an experimental operation, many ideas being developed as the work progressed.

The cost sheet from which those figures were taken was made up early in December. Some small parts of the work were not complete, and in a few instances estimates were substituted for actual cost. The work at Union was to include 40 houses. This was cut short, however, owing to war conditions. Possibilities of the future for cutting down labor cost may to some extent be judged from fluctuations in three of the major labor items on the twelve houses. These are given both as to hours and amounts paid for concreting, erecting forms and wrecking forms.

Study of the figures in Table 2 reveals the fact that while the average labor hours in concreting each of the 12 houses was 199, there was a fluctuation from 140 on house No. 10 to 243 on No. 11. The figures might suggest that there are great possibilities for economy in this system, when operations are thoroughly standardized and labor more stable. An interesting fact is that the concreting on the first house and on the ninth house was done in very nearly the average number of labor hours.

In erecting forms the average labor hours is 235—varying from 170 on the last house to 360 on the second one, with an average of 235. Time on wrecking forms

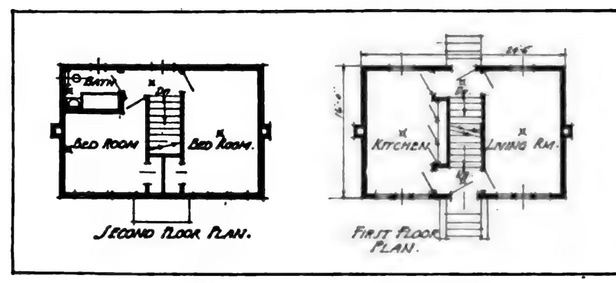


FIG. 5—PLANS OF FOUR-ROOM HOUSES AT PHILLIPSBURG

varied from 124 labor hours on No. 2 to 252 on Nos. 6 and 10, with an average of 199.

The concrete for the concrete houses is being mixed in a Koehring Dandie mixer and raised to the chute by an Ideal hoist. For the foundation work of the frame houses a Standard mixer, steam operated, is used. The Phillipsburg Development Corp. has the following personnel: F. M. Coogan, Alpha Portland Cement Co., president; Paul R. Smith, landscape architect and town planner, vice-president and general manager; James M. Fortune, treasurer; F. M. Overton, secretary; C. C. Stephens, engineer.

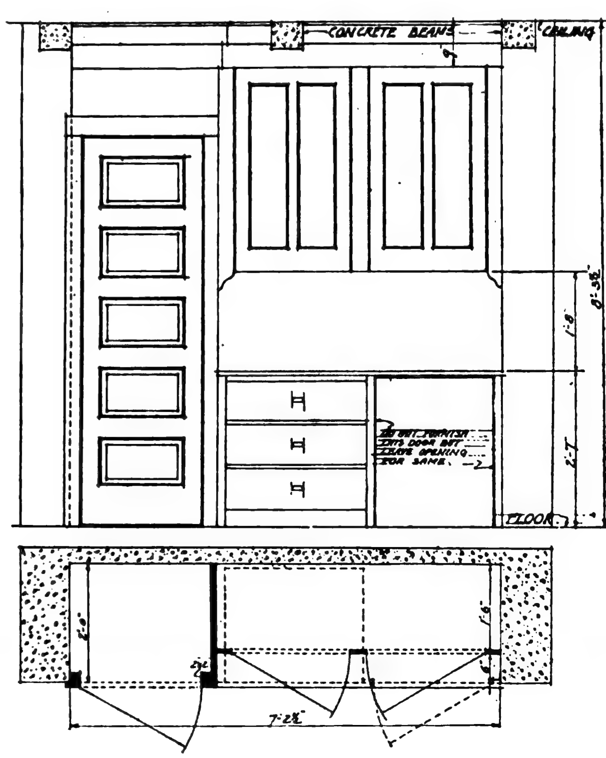


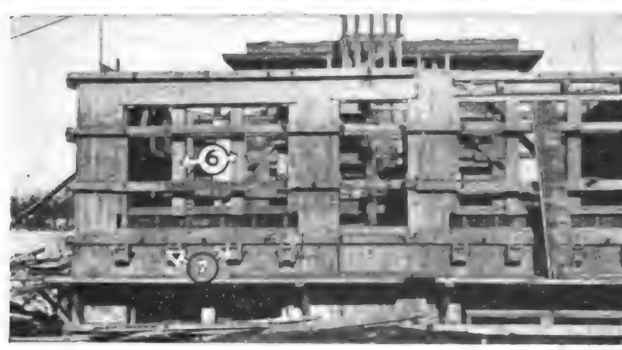
FIG. 6—DETAILS OF KITCHEN CUPBOARDS AND CLOSET

TABLE 1—AVERAGE COSTS ON INGERSOLL EXPERIMENTAL HOUSES

Material, etc.	Material Cost	Average Hrs.	Average Labor Cost
Building permits	$ 2.00		
Compensation insurance			
Excavation, 26'x18', 6"x8' 6", 65 cu. yds.			$32.31
Grading		33	16.34
Water		9	4.00
Sewer (this includes only the pipe laying, no septic tank)		27	17.55
Concrete, 65 yards—			
Cellar floor, steps and hatchway		110	59.10
Cement, 400 bags	240.00		
Sand, 33 yds.		97	39.27
Cinders, 65 yds.	48.00		
Labor		199	123.79
Erecting forms		227	158.39
Cleaning forms		38	14.87
Oiling forms		12	4.50
Repairing forms		4½	3.42
Wrecking forms		199	117.70
Moving hoist and mixer		30	18.00
Spreaders			
Reinforcing	67.00	10	5.66
Waterproofing walls, 17 gals. Ebonol at .40	6.80	24	11.52
Lathing—			
600 Mason lath, at .70	4.20		
1,050 ft. Bishopric board, at .32	33.60		
Labor		39	15.50
Plastering—			
55 bags Adamant, at .50	27.50		
20 bags Tiger brand, at .45	9.00		
¼ bbl. plaster of paris, at $3.85	.96		
Labor			75.00
Flue lining, 100 lbs., 26 Ga. black iron, 150 lbs., at 7.8 cts.	11.70		
Labor		12	8.30
Outside Stucco, ¾ ton Monument Stucco, at $28.00	21.00		
Labor painting walls, etc.		58	36.40
Stucco		136	50.00
Furring lath for groovings, 600 lin. ft. of 1 x 2, 50', at .04	2.00		
For furring 1,040', 90' at .04	3.60		
2 x 4 14/16'—150', at .05	7.50		
Labor		15½	7.80
Window and door frames—			
4 frames 7'4 x 4'6, at $2.50	10.00		
5 frames 2'8 x 4'6, at $2.50	12.50		
1 frame 2'10 x 6'6	1.00		
7 frames 2'6 x 6'6	14.00		
2 frames 2'4 x 6'6	2.00		
1 frame 2'0 x 6'6	1.00		
1 frame 3'0 x 6'4	1.00		
Roofing, 17 gals. Ebonol, at .40	6.80	19	9.00
Lattice, 8 ⅜x8" bolts	.80		
Lattice, at .64	6.40		
Front and rear hoods, 8 ⅜x8" bolts	33.71		
Roof paint	.30		
Bathroom floor	6.00		
Hours labor		32	24.00
Floors, regular, 225' 1x2 furring, 40' at .04	1.60		
730' flooring, at .07	51.10		
Labor		32	24.00
Stairs, two flights	42.74		
Inside trim	62.59		
Cupboard	27.05		
Labor		36	21.68
Sash, 12 2' 0 x 4' 6 x 1⅜ gl., at 2.04	24.48		
5 2'8 x 4'6, gl., at $2.58	12.90		
Cellar, 5 2'10 1'11 x 1⅛, at .84	4.20	10	6.64
Doors, 1 2'10 x 6'6 x 1¾	6.18		
7 2'6 x 6'6 x 1⅜, at $2.35	16.45		
2 2'4 x 6'6 x 1⅜, at $2.35	4.70		
1 2'0 x 6'6 x 1⅜	2.38		
1 3'0 x 6'4	2.35		
Labor		17	11.95
Rails	10.00		
Outside painting	2.00	9	4.50
Inside painting	6.00	48	24.00
Tinning, leaders, etc	15.40	28	10.50
Plumbing, roughing	34.90		
Fixtures	90.00		
Labor			40.00
Electric conduits	12.65	15	8.88
Trucking		30	13.14
	$997.36	1492½	965.66

TABE 2—COSTS FOR LABOR ON THREE PRINCIPAL OPERATIONS ON INGERSOLL HOUSE WORK

House No.	Concreting Hrs.	Concreting Amt.	Erecting Forms Hrs.	Erecting Forms Amt.	Wrecking Forms Hrs.	Wrecking Forms Amt.
1	187½	$137.90	261	$169.80	210	$119.55
2	230½	171.85	360	197.90	176	109.05
3	240½	143.70	260	181.15	124	87.65
4	154½	102.05	155½	181.15	180	124.10
5	187½	115.80	179	161.75	198	101.85
6	216	137.30	211	145.10	252	140.90
7	216½	136.65	208	128.55	168	114.90
8	161½	102.90	180½	128.75	218	115.80
9	191	106.15	197	129.35	216	129.40
10	140	100.35	212	156.55	252	157.88
11	243	134.65	332	177.85	175	99.86
12	215	96.16	170	82.79	222	111.87
Average	199	$128.79	235	$158.39	199	$117.70



FIGS. 7, 8 AND 9—PROGRESS VIEWS IN CONSTRUCTION OF HOUSES BY INGERSOLL SYSTEM

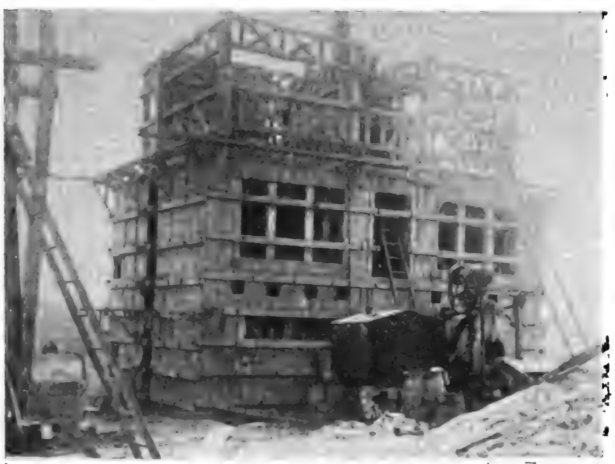
(1) Corner posts set up on wedge blocks; (2) truss-joint with post; (3) brackets on which trusses hang; (4) outside 4 x 4 strings to align form sections; (5) framework on which concrete skip is raised; (6) window frames in place; (7) forms for flower box brackets.

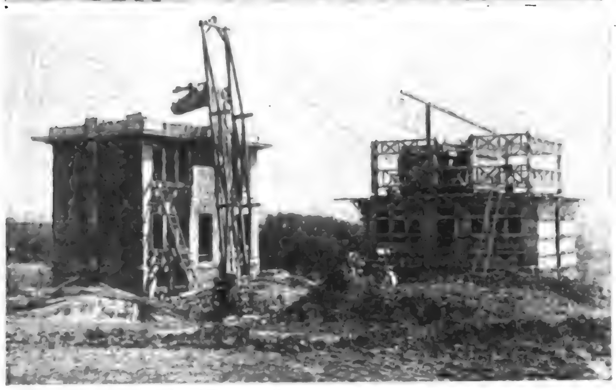
Abstracts From a Subsequent Article Descriptive of Phillipsburg Work[1]

Thirty-four houses are substantially completed. Six-room fireproof houses, with full basements and with concrete floors, walls, stairs and roofs, are being completed for $2,500, not including overhead, lot, or royalty payments on the use of the forms. An idea, however, of what this amounts to is gained from the fact that it is proposed to sell these houses, which are being built under an agreement with the Ingersoll-Rand Co., for its employees, at $3,250.

A real contrast is obtained from the fact that the Phillipsburg corporation has also erected 25 six-room frame houses on concrete foundations—houses that are more attractive in plan and general architectural treatment than the average house of its type for an industrial development, but nevertheless not in any way permanent or fireproof—at a cost of $2,300, as compared with $2,500 for permanent fireproof construction.

[1]From CONCRETE, August, 1919.





FIGS. 10, 11 AND 12—CONSTRUCTION VIEWS OF WORK AT PHILLIPSBURG

Basement floor being struck off in top view, and tower framework by which concrete is hoisted in big dipper bucket; center view forms set up to second floor level, with posts and trusses in place above; at bottom is a general view of the houses in progress.

FIG. 13—CONSTRUCTION VIEWS SHOWING FORMS SET AND CONCRETE, POURED, PROTECTED ON TOP WITH MANURE (COLD WEATHER); WINDOW OPENINGS CLOSED AND SALAMANDERS INSIDE; CENTER VIEW SHOWS STUCCO WORK UNDER WAY; BOTTOM VIEW, HOUSE COMPLETE EXCEPT FOR GRADING, STEPS, DOOR HOOD, LATTICE, ETC.

Costs of material and labor items entering into a six-room concrete house are shown in the accompanying tabulation.

Mr. Smith points out that these figures do not include overhead, which mounted rather high in a period of delay in getting the forms into action, due to organization which was necessary to maintain in a difficult labor market in order to have sufficient crew available when operations could proceed at maximum speed.

Excessive overhead, however, is not normal and does not represent the figure at which these houses are now being built, when the work is running more smoothly. Nor does the $2,500 figure represent what it is expected would be achieved if other sets of forms were available and with crews more thoroughly familiar with the operation of the system. With a system of this kind the most economical results are possible only in an undertaking of considerable magnitude, pushed to the limit of the possibilities of the Ingersoll idea in the operation of the forms—this involving *manufacturing* methods and a thorough standardization of a few simple operations.

It is pointed out by Mr. Smith that with the crew at Phillipsburg it is possible, not merely as a single record, but as a regular performance, to erect the forms for a six-room house complete, pour the house and be ready to move to the next job in a cycle of five working days with eleven men.

Economies have been effected in mill work through the standardization of everything entering into the house; also in plumbing, the rough work coming onto the job assembled ready to be put in the forms in a short time. Further than that, the cost has been reduced considerably as the plasterers have become familiar with the treatment of the exterior surface. The forms leave the walls fairly smooth. The surface is finished in two spatter-dash coats of Monument stucco, applied with

FIG. 1—ENTRANCE DETAIL OF INGERSOLL 6-ROOM HOUSE

brushes by three men in two days, using only 1,600 lbs. of prepared stucco. This is used in various tints—coloring matter already mixed.

COST OF SIX-ROOM CONCRETE HOUSE (NOT INCLUDING OVERHEAD ITEMS)

	Material	Labor	Total
Excavating	......	$80.62	$80.62
Sewer	$45.00	......	45.00
Waterproofing	10.00	17.76	27.76
Reinforcing	77.65	4.95	82.60
Erection	......	208.05	208.05
Wrecking	......	129.80	129.80
Pouring	290.60	73.36	363.96
Pointing	1.84	41.92	43.76
Moving equipment	......	4.25	4.25
Repairs	......	2.97	2.97
Foundation	36.94	24.58	61.47
Lathing	36.30	18.68	54.98
Plastering	38.00	74.53	112.53
Patching plaster	......	8.87	8.87
Outside stucco	36.41	67.03	103.44
Furring lath	41.33	30.08	71.41
Window and door frames	61.87	32.79	94.66
Porch	......	13.80	13.80
Dresser	18.43	10.28	28.71
Hoods	13.57	7.55	21.12
Floors	36.49	25.50	61.99
Stairs	33.94	22.20	56.14
Inside trim	51.73	47.39	99.12
Windows	75.21	10.22	85.43
Doors	20.42	10.56	30.98
Nails	3.37	......	3.37
Sash weights and cord	31.13	......	31.13
Hardware	14.14	......	14.14
Outside painting	......	8.25	8.25
Inside painting	23.16	70.18	93.34
Flower boxes	2.20	6.04	8.24
Tinning	3.84	......	3.84
Plumbing	188.24	84.35	272.59
Heating	90.00	7.22	97.22
Electric fixtures	30.00	19.50	49.50
Areaways	......	8.60	8.60
Cleaning	......	3.64	3.64
Shrubbery	15.00	......	15.00
Total	$1,326.81	$1,170.47	$2,497.28

66 Concrete Cottages at Manhattan Beach

Fig. 1 — Front View of a Street of Concrete Cottages at Manhattan Beach

Fig. 2 — Side View of Concrete Cottage — The "Pergola Porches" and Lattice Work Add Materially to Attractiveness

Fig. 3 — Concrete Cottages Under Construction — Note Derrick Lifting Wheelbarrows of Concrete

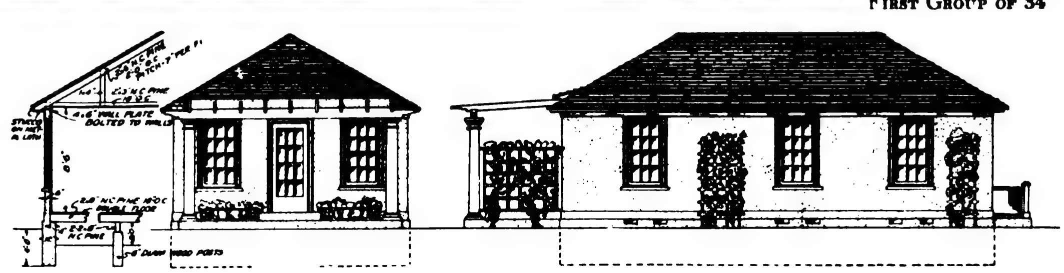


Fig. 4 — Section and Front and Side Elevations of Cottages in First Group of 34

Erect 66 Sea Shore Cottages of Concrete[1]

Thirty-four one-story seashore cottages, with walls of monolithic concrete have been built by MacArthur Bros. Co., New York, for the First Apartcot Corp. at Manhattan Beach, on Long Island. A second group of 32 cottages is now under construction. The cost of the first group was only 22.4c per cu. ft. This measurement was figured on one-half the roof and foundation height, and without taking into consideration the porch finished in pergola style and with concrete floor. To have figured this at one-half of its cu. ft. measurement, which is the custom with porch extensions, in arriving at cu. ft. cost, would have reduced the unit figure materially.

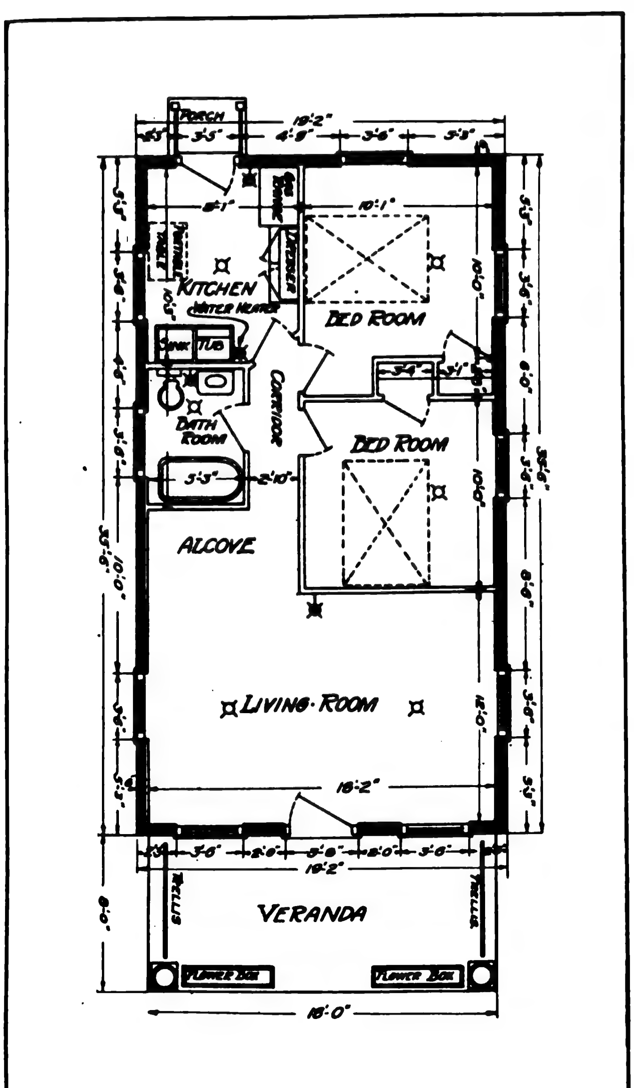


Fig. 5—Floor Plan of First 34 Manhattan Beach Cottages

[1]From Concrete, August, 1919.

Figs. 6 and 7—(Two Top Views) Forms for the 4' 6" Foundation Wall

Part of inside and outside forms erected and some reinforcing in place. Light frames bolted to inside forms serve as base for holding window frames in place.

Fig. 8—(Below) Steel Forms Being Erected

Unit costs of material and labor to get this result were as follows:

Cement	per bbl.	$ 2.80 net
Cinders	per yd.	.85
Sand	per yd.	1.35
Rough lumber	per M.	42.00
Mill work	per cottage	198.00
Common labor	per hour	.45
Carpenters	per day of 8 hours	6.50

The foundations are 4' 6" deep, 12" thick, and upper walls 6" thick, the foundation walls being cast with a set of unit constructed wood forms, these being used

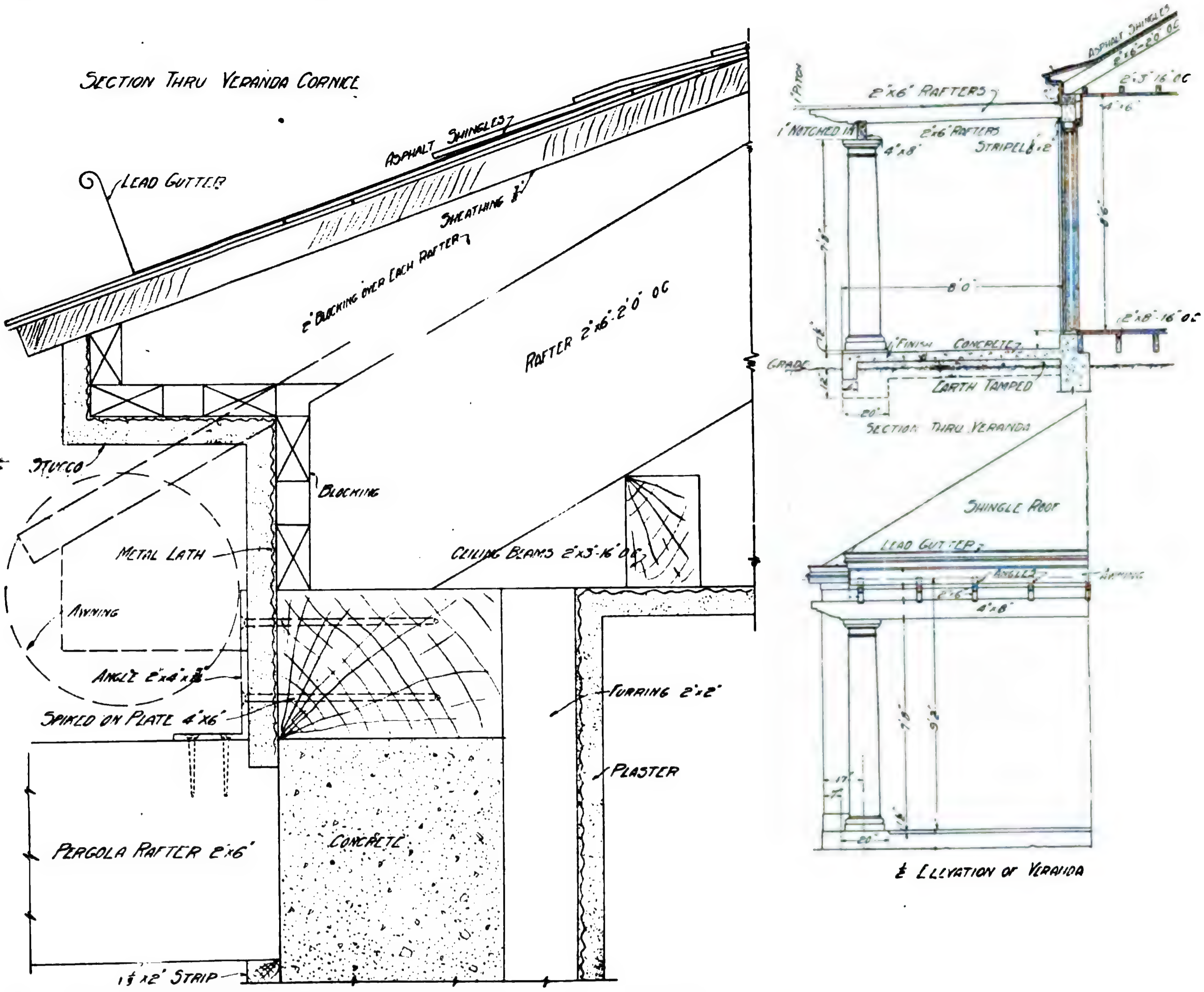


FIG. 10—DETAILS OF CONCRETE COTTAGES—N. K. VANDERBECK, ARCHITECT

FIG. 9—VIEW OF STEEL FORMS—SHOWING HORIZONTAL CHANNEL FORM TO WHICH UPRIGHT FORMS ARE BOLTED

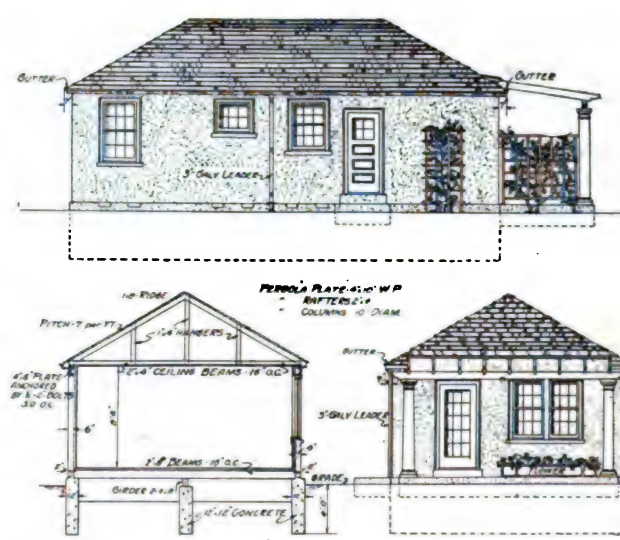


FIG. 11—ELEVATION AND SECTION, SECOND GROUP OF 32 COTTAGES

throughout the first group of houses, and with Lambie steel forms in channel units 12″ wide and a story in height. The concrete is a mixture of 1 part cement, 2 parts sand and 4 parts cinders, mixed in a Smith mixer, deposited from wheelbarrows which are dumped from runways against splash boards into the forms for foundations and lifted by a light derrick and tackle for filling the forms of the upper walls. The walls are reinforced with 3/8″ round rods, 18″ o. c. horizontally and vertically.

The surface of the concrete on a few cottages was gone over on the outside with stone cutting tools and with air hammers, exposing the black cinders and giving a very pleasing surface result. Most of the houses. however, were rubbed down with carborundum brick, rubbing in at the same time a neat cement grout. The inside walls are furred with 2″ x 2″ furring strips and covered with lath and plaster.

Illustrations show the interior arrangements of the

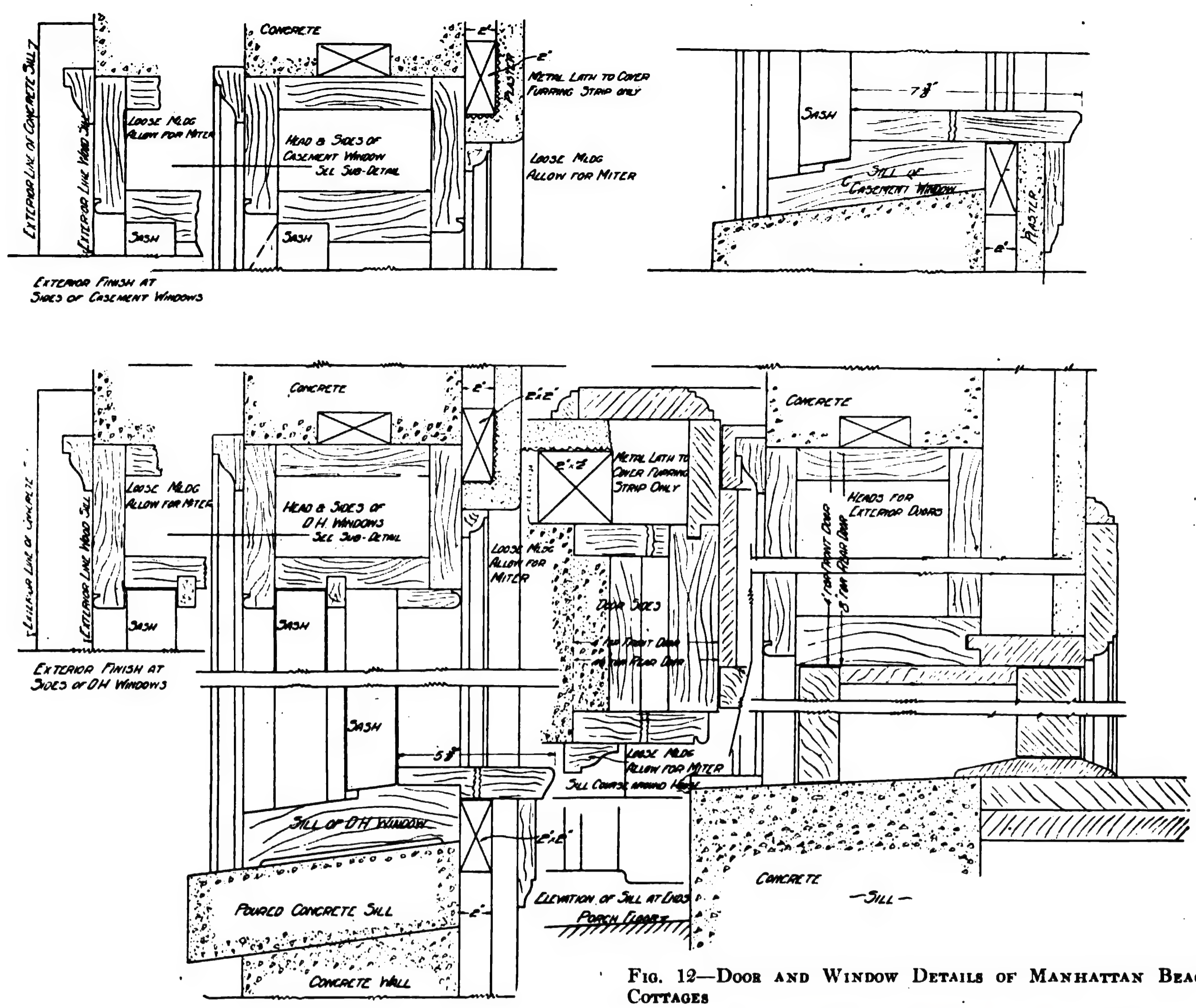


Fig. 12—Door and Window Details of Manhattan Beach Cottages

houses in the first group and of the second group now being built, in which the plan was slightly changed, although the over-all dimensions remain the same. Floors and roof are frame, the roof being covered with asphalt shingles with a green-gray slate surface.

Work was started on the first group of thirty-four houses March 3, and they were turned over for occupancy June 1. Before this date the matter of rental had been turned over by the First Apartcot corporation to Joseph P. Day, real estate operator, who advertised the houses with full page advertisements in two New York papers. About 1,000 applications for the cottages for a four months' season, on a rental of $500, were received. These were sifted down to 250 desirable applicants—so that it would have been possible to have rented the first group fully seven times over.

Fig. 13—Cinders Are Delivered by Barge and Cost 85c a Yard on the Job

Figs. 14 and 15—Charge and Discharge Ends of the Concrete Mixer

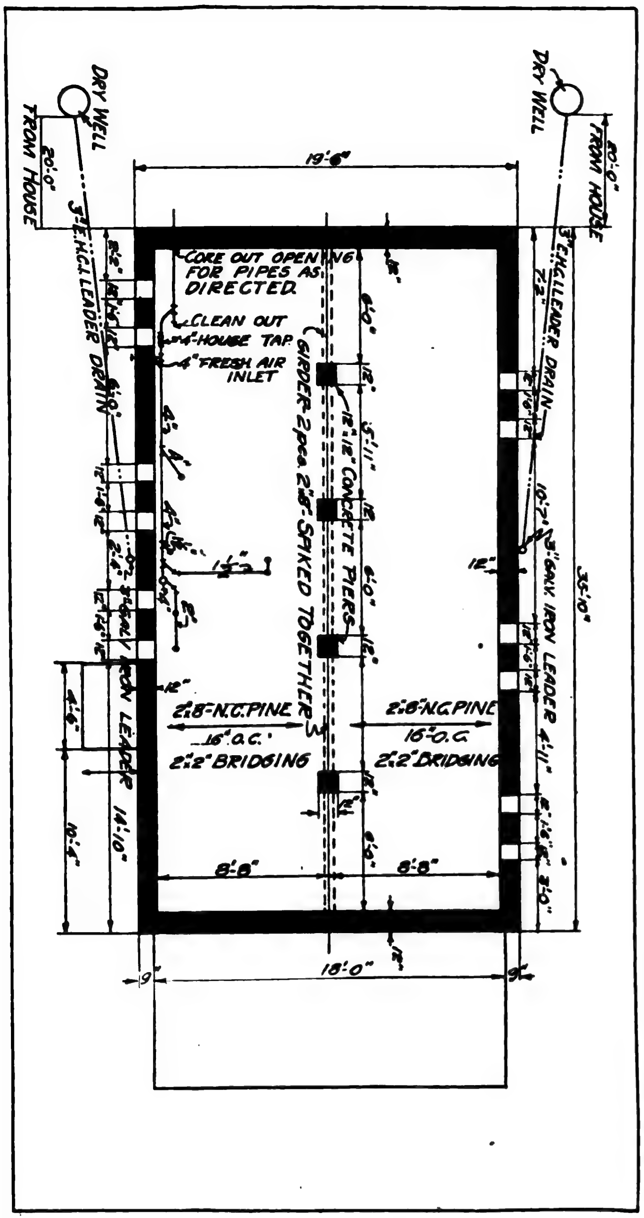


Fig. 16—Foundation Plan of Cottages

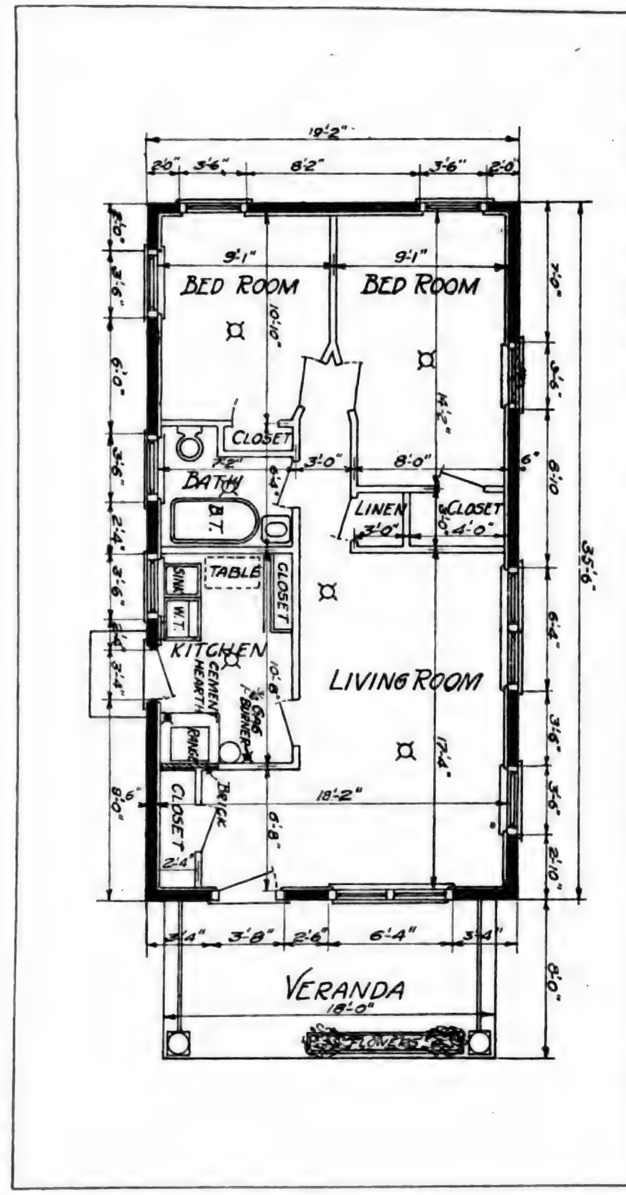


Fig. 17—Floor Plan of Second Group of 32 Cottages Now Under Construction

Preparations were made immediately to build the second group of houses, and if the demand continues the construction will also continue indefinitely.

The low cost in construction was attained in spite of labor difficulties.

The excavations for the low foundations were roughly scooped out in the sandy soil. Six carpenters set up two sets of the wooden forms for the foundation walls in a day, these being carried from one house job to the next by laborers and merely dumped into the trenches. These forms are illustrated.

In handling the steel forms the sections are just too heavy to be handled readily by one man, and made rather a light load for two. All bolts and keys are set by carpenters according to union rules.

FIG. 1—ARCHITECT'S PERSPECTIVE VIEW OF ROW OF TEN HOUSES FROM A SINGLE FLOOR PLAN, FOR HYDRAULIC PRESSED STEEL CO.

Build 20 All-Concrete Houses; Plan 20 Bungalows[1]

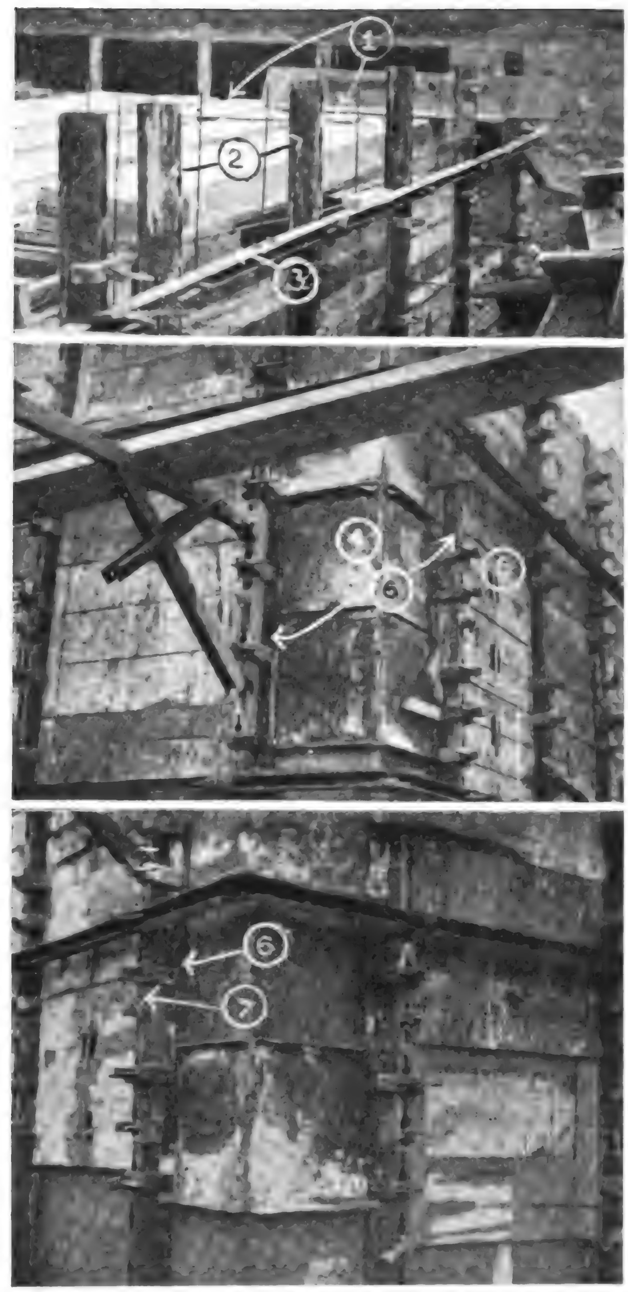
Twenty modern fireproof houses, six rooms and bath each, from a practically identical plan, but with exterior variation in roof and porch treatment to make an attractive row, are being built by the Craig-Curtiss Co., contractors, Cleveland, in what is known as the Cranwood allotment, for employees of the Hydraulic Pressed Steel Co. Plans are by Edward B. Smith, architect.

The major construction features in this work are involved in the use of a newly perfected set of forms, the details of which are shown in the accompanying illustrations, and in the employment of a concrete elevator developed by D. S. Humphrey, of The Humphrey Co., Cleveland, and used on work in the construction of cottages for The Humphrey Co.

It was first planned to build 20 of the two-story, six-room houses in a row, half of that row being shown in a perspective drawing, which is reproduced in Fig. 1. This gives an excellent idea of the varied treatment of a single plan. This feature is further shown in accompanying illustrations from pen drawings. The plans used are also shown. Subsequently, the nature of the development was somewhat changed and it was decided to add still further variety to the scheme by making every other house of the bungalow type, all of these also built to a single plan, but with variations in treatment as shown in sketches.

The six-room and bath, two-story houses are being built first. The present contract involves 20 of these

FIG. 2—"HYDRAULIC" HOUSES UNDER CONSTRUCTION



FIGS. 3, 4, AND 5—(TOP TO BOTTOM) CONSTRUCTION VIEWS. AT TOP, FORMS UP TO FIRST FLOOR AND "PAN" FORMS IN PLACE. CENTER AND LOWER VIEWS SHOW FORMS FOR UPPER WALLS

(1) Pan forms for beam and slab floor; (2) vertical pressed steel ribs holding forms and supporting structure; (3) horizontal channel iron keyed to ribs for alignment; (4) corner forms; (5) form plates between ribs; (6) "U" bar locking device, with slotted key and wedge to tighten against vertical ribs; (7) Universal clamp for tie rods.

[1]From CONCRETE, January, 1919.

Fig. 6 — Six Bungalows from a Single Plan

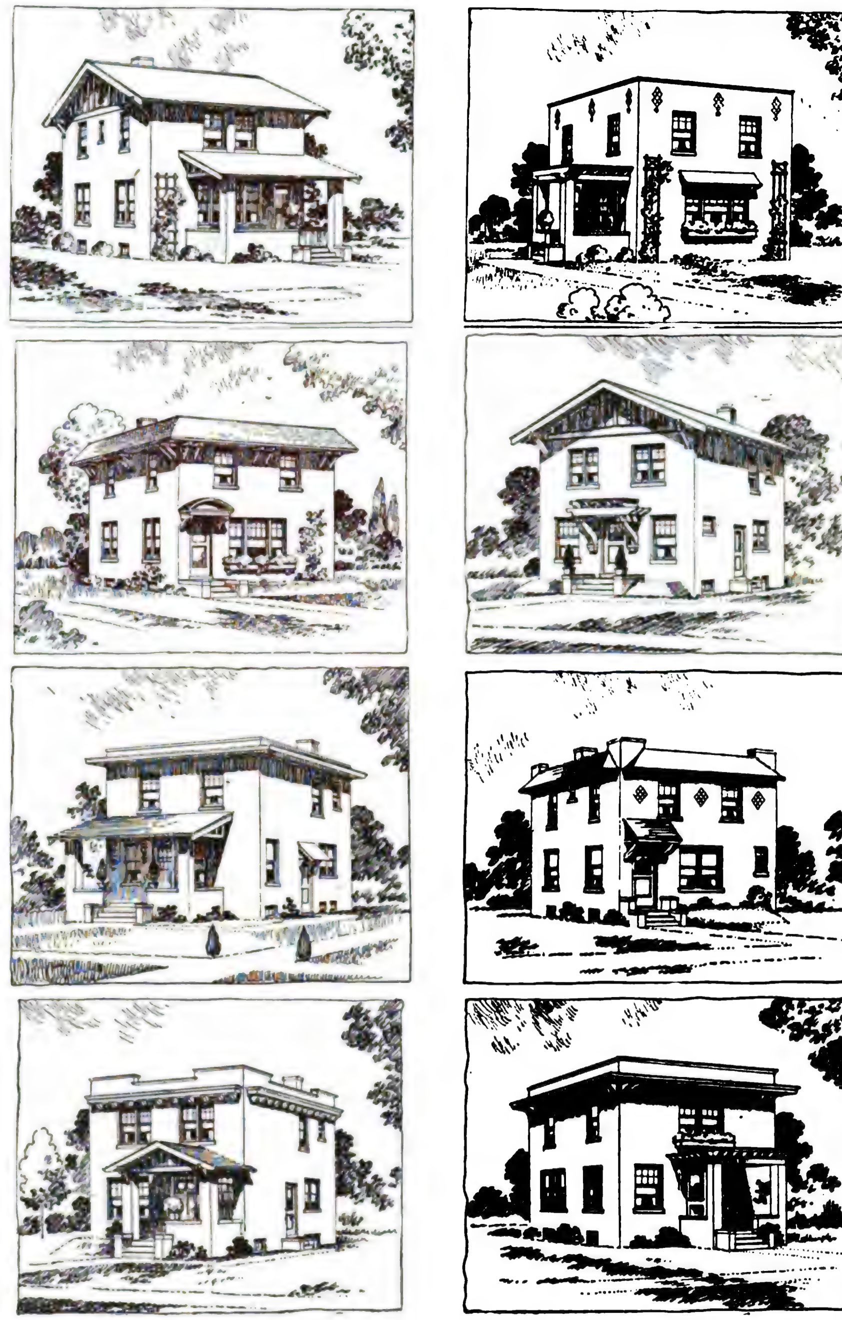


Fig. 8—Eight Houses from a Single Plan (See Fig. 9)

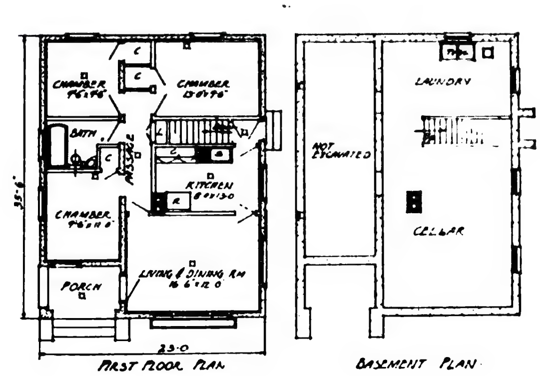


Fig. 7—Bungalow Plan

dwellings. These will undoubtedly be followed immediately by the construction on intermediate lots of 20 bungalows. The estimated building cost of the houses was originally fixed at $4,800, but the work thus far indicates that there is likely to be a saving under this figure, which is unusual on a job employing relatively new equipment and on something of an experimental undertaking in the handling of forms with which the contractor was not familiar.

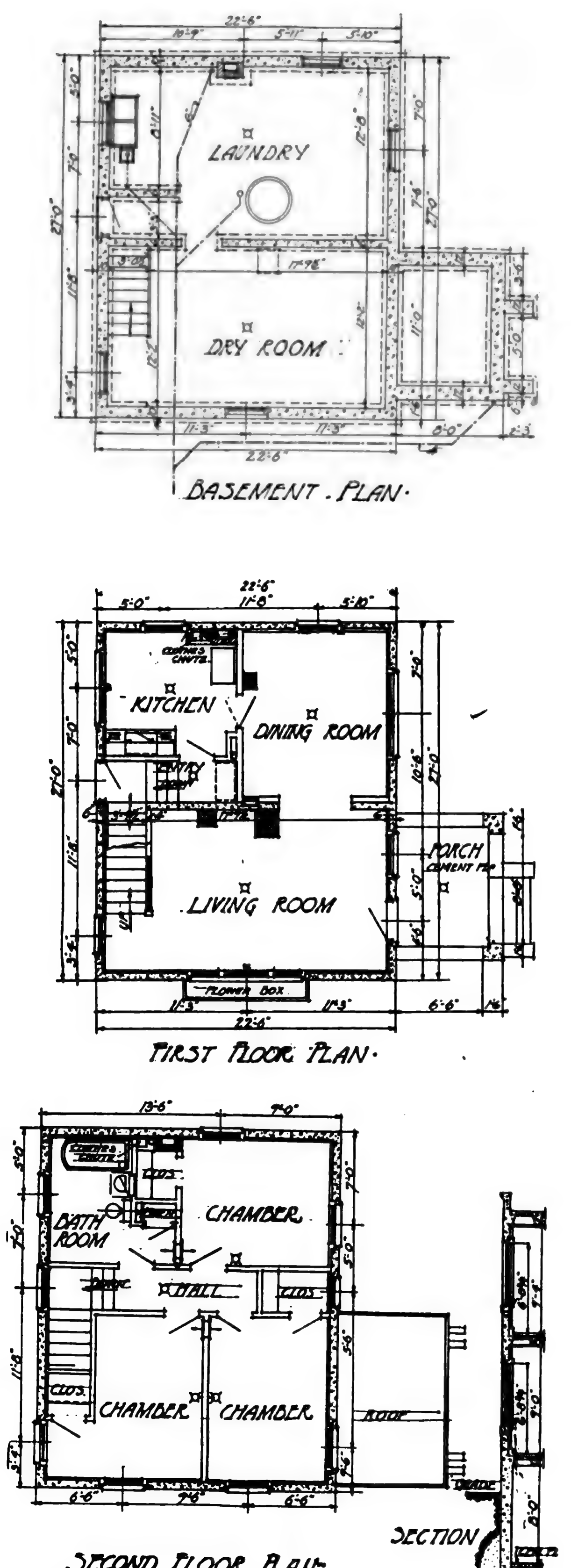


Fig. 9—Floor Plans of Hydraulic Pressed Steel Houses (See Fig. 8)

The figures in the original estimate by the contractor cover two types of house, one with a flat roof, all concrete, and the other with a frame pitched roof over a light concrete ceiling slab. The items of cost are noted under two headings—E and F, Type E indicating the house with the pitched roof and Type F indicating the house with the flat roof.

	E—Pitch	F—Flat Roof
General conditions and supervision	$ 70.00	$ 70.00
Concrete and masonry	1,469.04	1,725.01
Reinforcing steel	120.00	130.00
Carpenter work	682.44	507.65
Mill work and glass	312.00	312.00
Gypsum partitions and furring	353.75	353.75
Roof, tar coat and 6" loam	110.00	64.00
Sheet metal	92.00	20.00
Lath and plaster	310.00	312.00
Painting and wall paper	240.00	225.00
Hardware	28.00	28.00
Plumbing	450.00	450.00
Electric wiring and fixtures	116.00	116.00
Furnace	140.00	140.00
	$4,494.22	$4,454.22

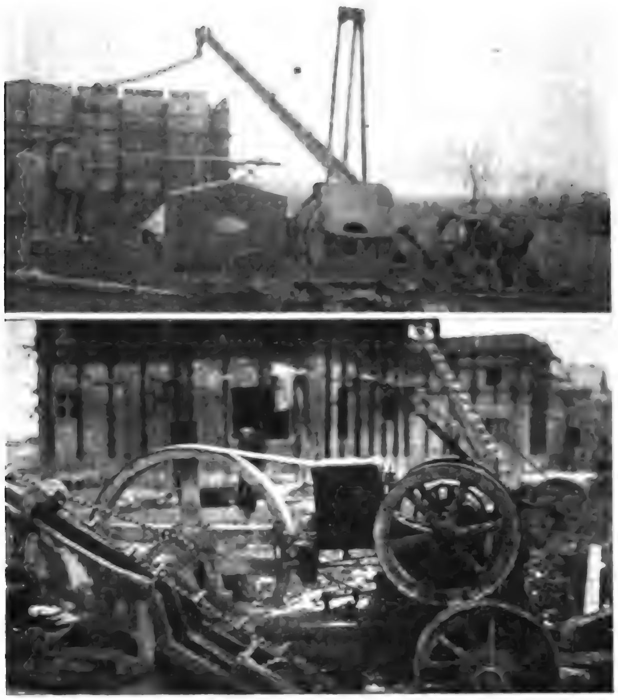
The houses are 27′ x 22′ in plan, 27′ high, and contain 16,038 cu. ft., or 594 sq. ft. The estimates are based upon the cost of 4¾ cts. per lb. for reinforcing steel; $2.47 per bbl., net, delivered, for cement; labor at 60 cts. an hour; carpenters at 80 cts. an hour, the union scale. There are about 100 cu. yds. of concrete in each of the houses. The walls are 10″ thick in the basement and 6″ thick for the upper floors. Furring of the interior walls is figured on a basis of thin gypsum block, on which the interior plaster is to be applied. A chase is provided in the walls for piping and wire conduits are run between the sleepers on the concrete floors and under the wood finish, no pipes or conduits being embedded in the concrete.

The Forms

The forms which are being used and which have been under development for several years, consist first of vertical T-shaped ribs and horizontal lining members, both of pressed steel, and plates approximately 2′ x 3′ in size, built of wood and rimmed and lined with steel, which are set in place between the ribs and held in position by U-shaped clamps which go over the ribs and key solidly in place. The only tool required in erection or wrecking is a hammer. Ribs and liners are first erected and a portion of the forms placed and reinforcing set inside. The interior is always accessible, owing to the possibility of the easy removal of a form panel or plate at any time. The ribs also support the staging. Universal clamps hold the tie rods. The details of this construction are shown in accompanying illustrations from photographs. [In spite of the apparent satisfaction with this work, when it had reached the stage illustrated the Hydraulic company has withdrawn the forms from market for further development.—Editor.]

The experience on the job at the Cranwood allotment has been that four men can erect the forms and be ready to pour a story height (this much being handled at one time) in three days. This includes the setting in of the 2 by 6's with shoring and "pans" to form beam and slab concrete floor.

With an Elite continuous mixer, the Humphrey concrete elevator, which consists merely of a metal lined trough with sprockets and chain carrying metal paddles or blades, which move very rapidly, has been in use on part of the work, and a Koehring Dandie batch mixer, with a similar elevating device and employing a Novo 6 h. p. engine, has been used also on some of the houses. Up to December 1 it has taken nine men about 6 hours to mix and place the concrete for a one-story height,



FIGS. 10 AND 11 (TOP) GENERAL VIEW AND DETAIL OF ELEVATOR SYSTEM FOR CONCRETE PLACING

including one floor. Much better speed is expected than this, because much better speed was obtained by the Humphrey Co. with similar equipment in the erection of cottages in Euclid Beach Park, as CONCRETE has previously described.

The day after the walls are poured, the form sections between the vertical ribs of the walls may be taken down and the surface gone over with a wire brush, to give a very acceptable surface texture, particularly with the gravel aggregate which is being used. The removal of ribs and liners is done somewhat later, depending a great deal upon weather conditions, and the narrow panel effect, which is left in the concrete by the smooth face of these ribs, may be retained as an architectural feature of the design, or these smooth bands may be removed and the surface made similar all over by going over this comparatively hard concrete surface with a pick or bush hammer. The earlier removal of the form panels themselves makes it possible to run a job where a number of houses are being built with no more than two sets of forms and three or four sets of ribs.

The construction is being financed as welfare measure by the Hydraulic Co. A street with forty lots was selected, with the expectation of putting up twenty two-story houses and twenty bungalows, of ten distinctly different designs, except for the plans, which are alike for all the bungalows and all the two-story houses.

In financing the enterprise the Cranwood Allotment Co. turned over to a trustee for this enterprise forty lots on one street. The Hydraulic Co. turned over to the trustee sufficient money to insure the construction of the houses. This trustee entered into a contract with the Craig-Curtiss Co. for the construction of the houses, on whose cost a detailed estimate was made. Any cost over and above this estimate price is to be borne half and half by the Hydraulic Co. and by the contractor, and any profit resulting from the erection of the houses at a cost less than the estimated cost will be equally divided.

As fast as the houses are completed, including decorating, sidewalks, all improvements in the street, furnaces, electric wiring and fixtures, window shades, etc., they will be sold to the Hydraulic employees. Each employee makes a deposit of $250 or more per house. This employee must, however, be acceptable to the Equitable Life Insurance Co., as to habits, amount of salary earned, health and so on, the insurance company issuing to him a life insurance policy and making a loan of 50% to 60% of the value of the house, on a first mortgage. The money realized from this mortgage is turned back to the Hydraulic Co. as a first payment, and the employee carries his premium on his insurance, the interest on the second mortgage and the payment on his house in a lump sum per month. The first mortgage held by the insurance company is paid off in ten years' time by means of monthly payments. In case of death, the life insurance covers the first mortgage, which is immediately paid, and whatever amount has been paid in on the principal is then turned over to the estate of the insured.

The estimated cost of the houses now being erected is $4,800 each, and the cost of the lot $700, making a sale price to the employee of $5,500. This includes no profit whatever on the transaction to the Hydraulic Co., and a lump sum profit of between $300 and $400 to the contractor. The houses have been appraised from plans at a worth of at least $6,000 to $6,500 by the insurance company. The amount of the premium on the life insurance policy will, of course, depend upon the age of the purchaser. For a man about 30 years old, a total monthly payment, including the premium on the insurance, the interest on the first and the second mortgage and the reduction of the principal of the first mortgage in ten years' time, amounts to about $48.00 to $50.00 per month. These houses are for the better class of employees.

FIG. 1—GENERAL VIEW OF HOUSE BUILDING AT DONORA, PA.

Monolithic Houses at Donora for Steel Mill Operatives[1]

BY C. D. GILBERT

The American Steel & Wire Co. has an extensive plant at Donora, Pa., about 20 miles southeast of Pittsburgh. The increasing demand for dwellings for employees resulted in acquiring a tract of land on a hill overlooking the plant, which is being sub-divided by the company and covered with houses, to be rented and sold to employees. In any undertaking of this magnitude certain fundamental conditions must govern. It has become axiomatic that the workingman can pay about one-fourth of his wage for shelter. More than this becomes prohibitive. The essential consideration is, therefore, to build a house that shall care for the workman and his family within a total investment, the charges for which, including depreciation, shall not be in excess of an amount which approximates the weekly wage.

Employers have been accustomed to figure investment and depreciation, in connection with tools and plants, from a standpoint of the service to be rendered by a given purchase; it is but natural, therefore, that a form of construction should be sought that will secure the utmost permanence. These two considerations at once suggest concrete. It remains to devise the means by which the low cost concrete house of permanent character can be built.

This problem was brought to the attention of the Lambie Concrete House Corp., recently formed to specialize on the housing developments of this character. Associated with the company as general manager is L. Brandt, who for years has made a close study of industrial housing problems. Readers of CONCRETE will remember descriptions of various operations where the steel forms developed by F. D. Lambie[2] have been used; they consist essentially of structural steel channels in standard sizes, with holes so located that they can be locked together securely by means of clips and wedges. The really essential feature of these forms is the belt course detail, which forms a 2" projection at each story and is the foundation on which the forms for the next story are placed. The experience gained from a number of years' work with these forms, coupled with Mr. Brandt's experience in housing, was brought to bear upon the problem at Donora.

DESIGNING THE HOUSES

It was decided in designing these houses to use concrete throughout as a structural material, including walls, floors, roofs and principal partitions.

The walls are solid, but provision is made for furring and plaster, thus providing the necessary air space for insulation.

While the flat concrete roof is the logical covering for a concrete house, it was believed that the public would not be entirely satisfied with this type, and as a concession to the taste of the occupant and the necessity of some form of insulation for the ceiling, the concrete cornice and roof slab are poured and a low-pitched false roof of asbestos shingles on a wood frame is placed over it.

When designing these houses the builders wished to make the fullest practical use of concrete. They realized, however, that for business reasons it would be necessary to make certain concessions to a public taste that has not been educated to approve all the conditions demanded by the economical all-concrete house. To meet the requirements of tenants, and to vary the appearance of the street, 8 houses were designed. These designs were very carefully studied, not only as to their individual convenience, but with relation to one another. The result is an unusually valuable collection of 4- 5- and 6-room single and double house plans that will well repay the careful attention of builders of small houses and students of industrial development.

THE FEATURES OF THE PLANS

Double Houses—The accompanying plans show that of the 8 houses, 3 are double and 5 single. The smallest apartment provided consists of four rooms. This is built

[1]From CONCRETE, Jan., 1917.

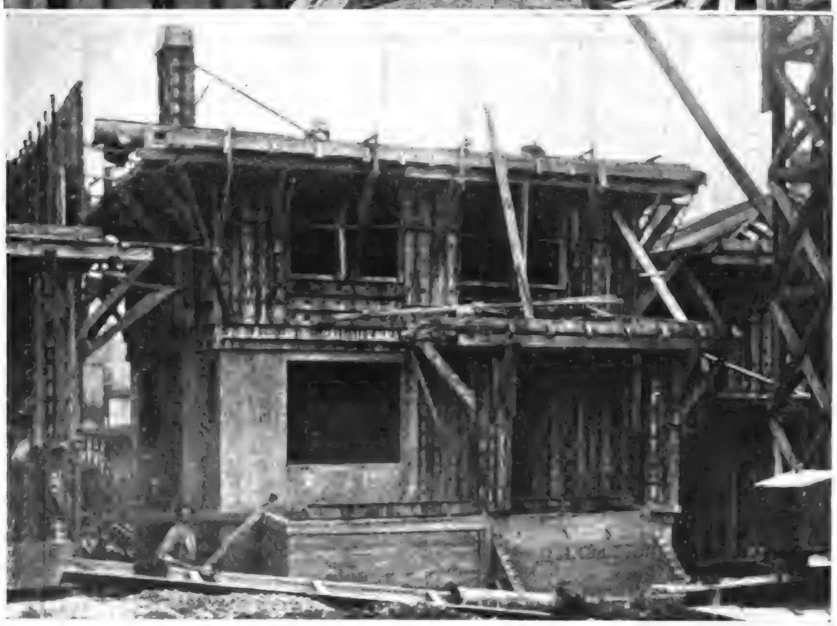


Fig. 2—Houses in Various Stages

Fig. 3—Typical House, Second Story Poured, Lower Walls Partially Stripped

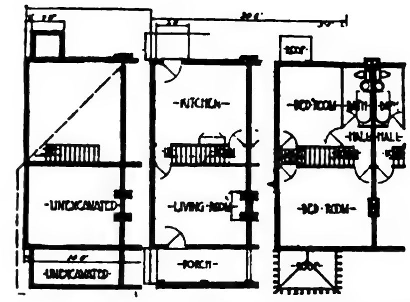


Fig. 4—Plans of Double House, Four-Room Apartments

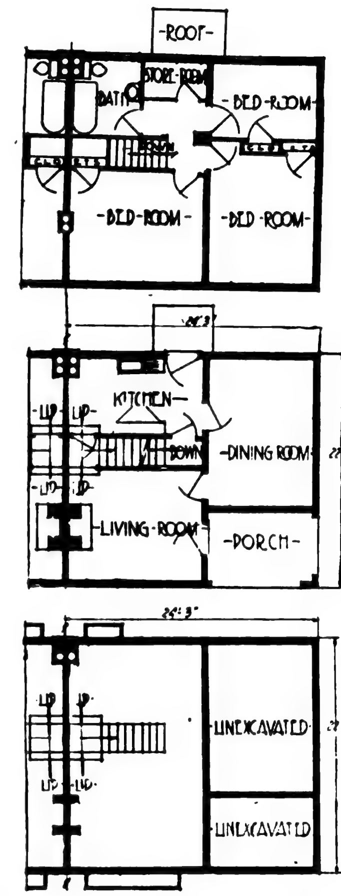


Fig. 6—Plans of a Double Six-Room House

as a double house and illustrated in Fig. 4. Each side of this house provides a living room, 12′ x 14′ 6″, with a combination dining room and kitchen of approximately the same size. Two bedrooms, closets and a bathroom occupy the second floor.

The five-room double house (Fig. 5) has, on the first floor, a small entrance porch and hall, a living room, 11′ 6″ x 13′, a kitchen and a dining room. An attractive fireplace is provided. The second floor has a large bedroom and two small ones, with good closet space and bath.

A still larger double house of 6 rooms offers an ample porch and an attractive living room with fireplace and a dining room and kitchen on the first floor. The second floor has three bedrooms, bath and storeroom. This plan is shown in Fig. 6.

Single Houses—The single houses offer a still greater choice of arrangement. One of the simplest is shown in Fig. 7. This house has a full basement equipped with laundry trays, a living room 19′ 9″ x 12′ 3″, with an attractive fireplace and open stair as the features. The dining room is approximately 12′ x 12′, and with a small but well arranged kitchen occupies the remainder of the first floor. On the second floor the principal bedroom faces the rear, while two smaller bedrooms occupy the front of the house.

The illustration (Fig. 9) shows a house 26′ x 26′, with an entirely different arrangement. Here the full basement with laundry trays is provided, but on the first floor a cut under porch gives entrance to the living room, which is located at the side instead of the front of the house. This brings the dining room to the front of the house and the kitchen to the rear. The features of this house are a handsome fireplace and a stairway so located that a door from the kitchen screens the stair and gives what is essentially a private access to the second story without necessity for passing through the living room. Three bedrooms and bath on the second floor are secured, with very little waste space. One of the features is a double closet in the principal bedroom providing for individual requirements.

The house shown in Fig. 10 is slightly smaller than the one just described. It has a large porch across the entire front of the house and a living room which occupies approximately half of the first floor. The dining room is of generous size, which makes economy necessary in the kitchen arrangement. This has been well worked out,

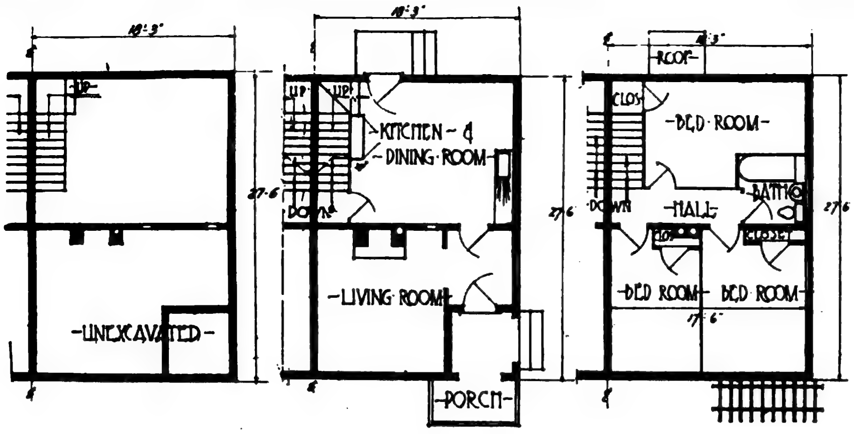


Fig. 5—Floor Plans of Five-Room House Built as a Double House

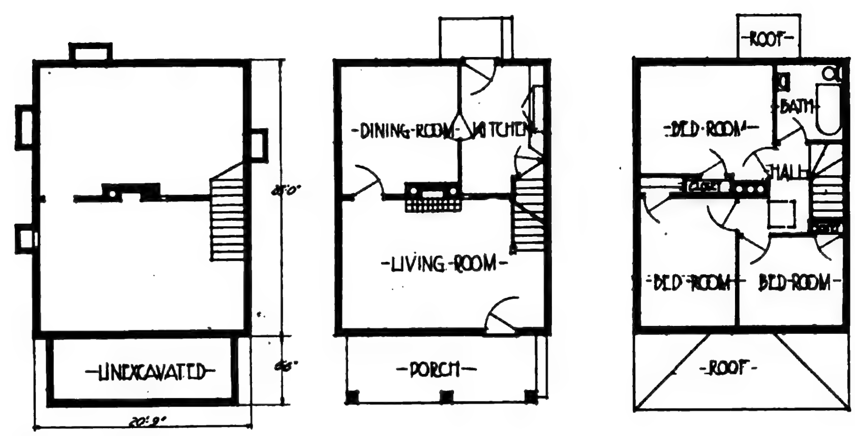


Fig. 7—A Simple Arrangement—Five Rooms and Bath

however, the kitchen being divided into a workroom and a pantry, each having an outside door. The location of the stairs is very economical of space. Three bedrooms with generous closet room and bath occupy the second floor.

The house shown in Fig. 11 will appeal to those tenants who like a large kitchen workroom at the sacrifice of living room space. From a comfortable porch 12′ x 13′, the living room is entered directly, and to the left is the dining room, 9′ x 12′. The kitchen is of generous size, 10′ x 14′ 9″. The stairway is not featured, the stairs to chambers and to basement and cellar being in a passage between the dining room and the kitchen. Very little hall space is needed on the second floor, and three very good bedrooms are secured.

The house shown in Fig. 12 gives still another choice arrangement. A large front porch opens direct to the living room, and an open stair leads one directly to the second floor. The generous living room, with its hospitable fireplace, shares the first floor equally with the dining room and kitchen, while the second floor shows still another arrangement, with three bedrooms and bath, necessitated by the stair location.

Construction Methods

Streets on which future houses will be built are under construction and the necessary public utilities being installed ahead of the house building. The present season about 30 houses are being built and at the time the pictures were taken were in all stages of construction. Operations were begun on two streets at right angles to each other. The location is well shown in Fig. 1, which is a general view taken from the hill above.

A number of problems had to be solved on account of the site. From the railroad where supplies are received, a winding road about 4,000′ long, with a rise of about 500′, gives access to the site.

Receiving and Handling Materials—The principal materials used are Universal portland cement, which is received in bags; sand and slag, from ¾″ down. These materials are received in the company's yard at the railroad level. A Champion bucket elevator, operated by a 6 h. p. Novo engine, elevates the aggregates to a three-bin structure, from which they are delivered to a 3½-ton Mack truck with hydraulic dump. An interesting comparison of haulage costs is afforded in this connection: To haul aggregates 4,000′, with 500′ rise, on good roads, by teams hired at $6.00 per day, cost about 55 cts. per ton. The truck, which is owned by the contracting company, does this work at 15 cts. per ton for operating expense. This covers investment but not depreciation. The driver is paid $3.50 per day, with helper at 30 cts. per hour.

Distribution—The big problem confronting the builders of this group of houses was economical distribution of the concrete. While the work is scattered over a very large area, it is obvious that the quantity of concrete handled is, comparatively speaking, very small, and for this reason the distribution system which was adopted, while it seemed the best available at the time the work was started, will probably not be used on similar operations because of the disproportion of its size and capacity to the yardage involved. The illustrations show well the arrangement, which consisted of two wood towers operating Wylie spouting. Towers were located so as to each cover an entire street of houses and take advantage so far as possible of the natural rise of ground.

The mixing and hoisting plant consists of three Koehring Dandie mixers, operated by a Fuller-Johnson

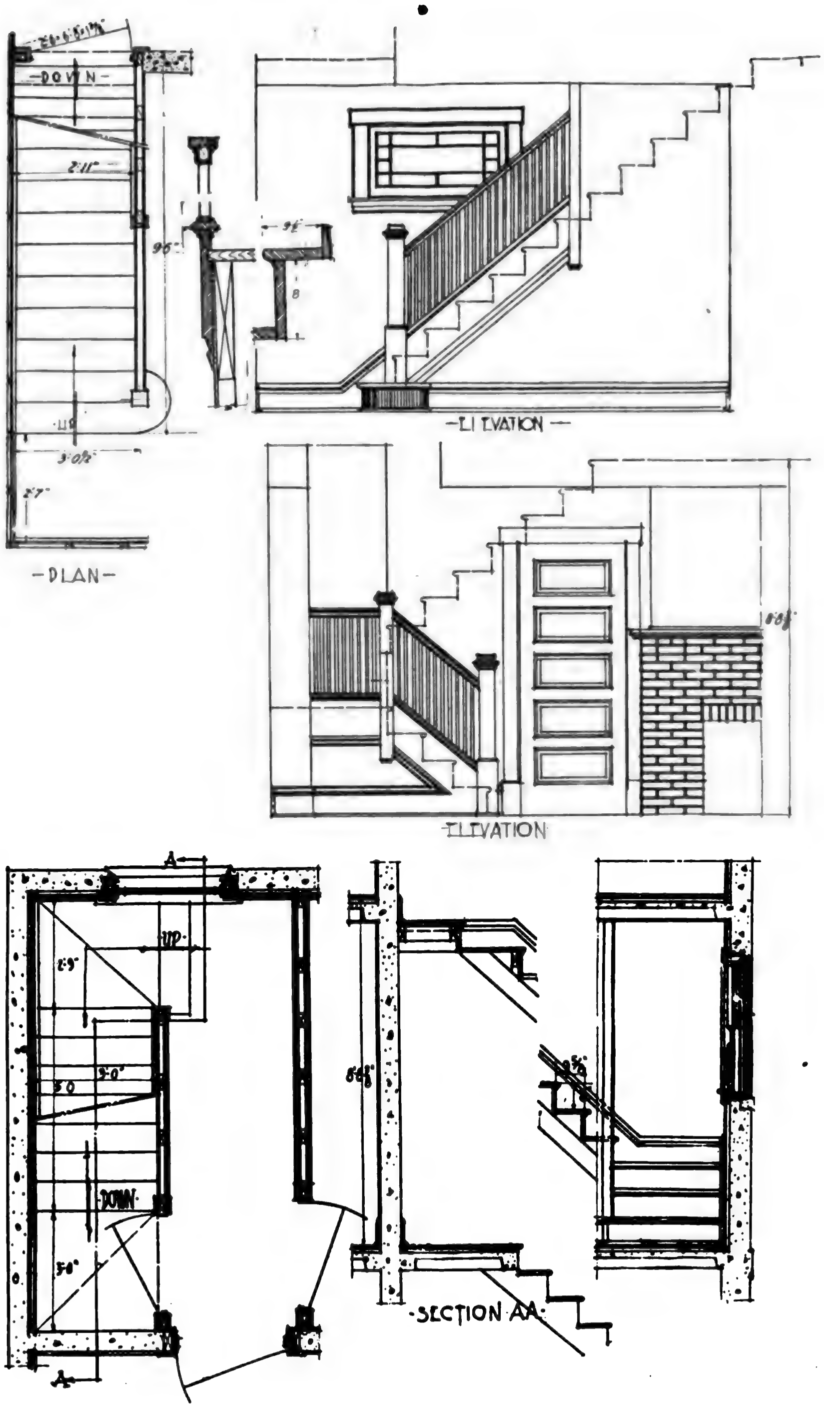


Fig. 8—Stairway Details to Accompany Plans in Figs. 9, 10 and 11

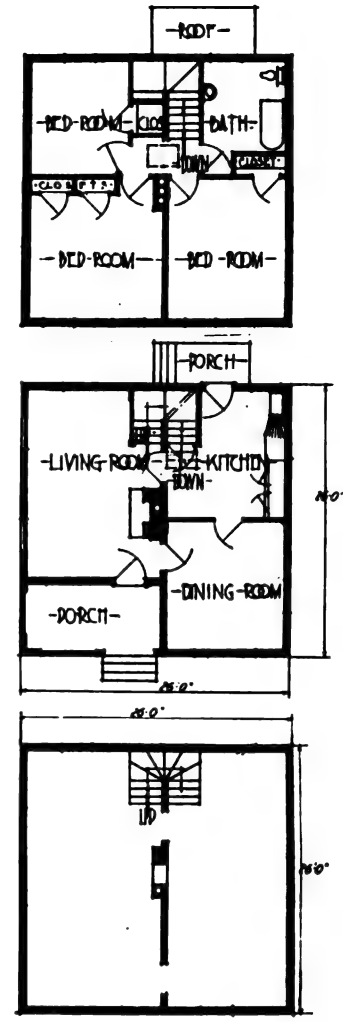


Fig. 9—Six Rooms and Bath—A Compact Arrangement

5 h. p. engine. The hoisting is done by two Novo hoists, with a capacity of 1,600 lbs. at 8′ per minute. The mix is 1:2:4 cement, sand and ¾″ slag.

Construction Details

In Fig. 2 and Fig. 3 are shown illustrations of the steel forms partially in place for the pouring of houses, and a detail of the work well under way. In setting the forms a horizontal course of steel channels is set on the footing, on which vertical channels are fixed for the walls. The construction is well shown in Fig. 3 and is the standard Lambie construction. It has been felt by some that this form of construction, while effective, could be considerably lightened, and the cost of handling and the investment in the heavy metal forms reduced. The present company has made an excellent start in this direction, and in Fig. 2 it will be seen that wood panels of standard sizes are being substituted for the steel. This is working out very successfully, greatly reducing the weight of the panels and cost of placing.

Spreading of the wall forms is prevented by carrying the reinforcing at each floor, which consists of round rods, through the forms. A considerable number of these rods are threaded at each end and attached with sleeve nuts, to a threaded stub, which passes through the belt course channel and by means of nuts on these threaded studs the belt courses are lined and kept in alignment. See Fig. 13.

Floor Construction—The construction of concrete floors of suitable economy for houses of this character has been a problem entirely solved. It is believed by many that the concrete itself will eventually be used with suitable surface treatment. As a concession to the occupants, wood finish floors are used. The concrete floor construction is noteworthy, although it is in a sense nothing new. It is an adaptation of the pressed steel tile, so extensively used for industrial buildings, to a much lighter floor. The extreme lightness is, however, a noteworthy feature and would be considered radical by many. For this work special G-F Steel-Tile were made. The reinforcing consists of bars, but in the bottom of each beam is embedded a light strip of wood to serve for nailing furring, while wood screeds are provided in the top for nailing floors.

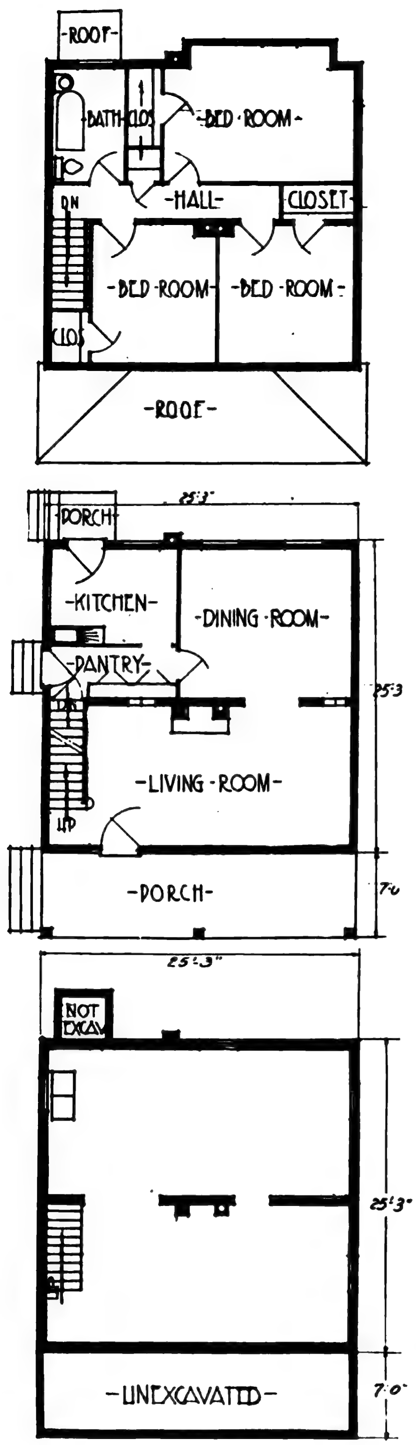


Fig. 10—This Plan Makes a Livable House

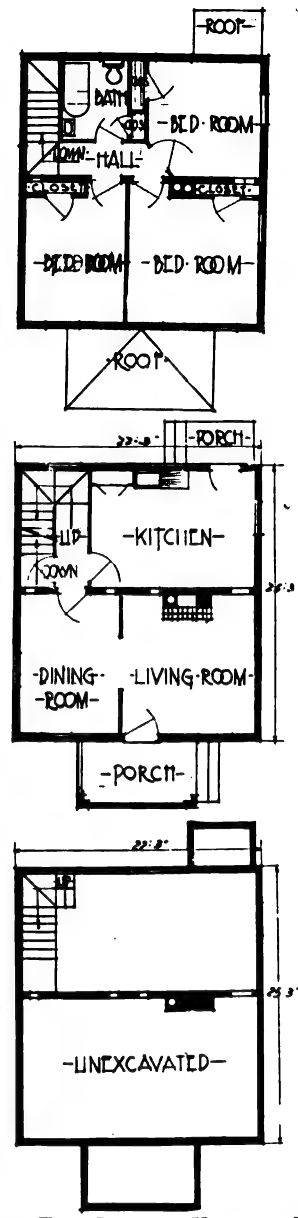


Fig. 11—The Spacious Kitchen Is the Feature of This Plan

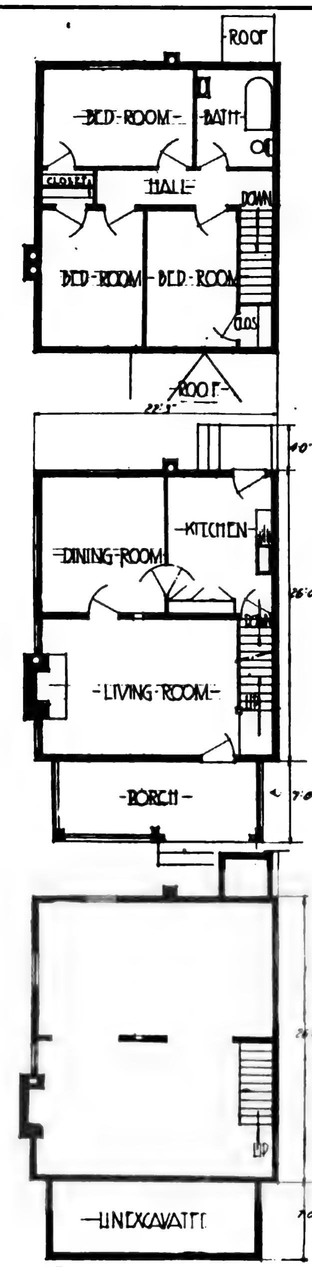


Fig. 12—This Plan Offers a Large Living Room and Commodious Porch

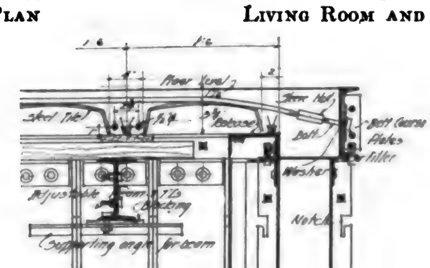


Fig. 13—A Form Detail

Fig. 14—Groups of Houses Under Construction; at the Right They Are Nearly Complete, Stucco Being Applied

Fig. 15 — Detail of Concrete Gutter and Wood Roof Frame

Fig. 16 — One of the Porches

Interior Details—Horizontal nailing strips are affixed to the forms of the inside wall, which provide a nailing for vertical furring strips on which are nailed Sackett plaster board. The ceiling is also covered with Sackett plaster board nailed to furring, which is, in turn, nailed to the strips provided in the floor beams.

While principal partitions are of concrete, some wood stud partitions are used which are covered with Sackett board. This construction is believed to be a rational combination of the good qualities of concrete and the easily workable qualities of other materials to achieve a result that will appeal to the popular taste and still go a long way to impress upon the residents the value of concrete as a house building material.

The interior work is plastered with gypsum mortar, white coated, while the exterior walls are covered with Oriental stucco. Varied shades of gray, buff, yellow and pink are used.

Heating System—Hot-air furnaces were chosen as the best means of heating houses of this character, especially where the heating plant is in the hands of tenants. Experience has shown these builders that the running of heating ducts in concrete walls is not entirely satisfactory, as the tendency to conduct away the heat in the walls is considerable and in case of repairs being needed the work is rendered very difficult. A modification was therefore made by arranging the ducts so as to come in inconspicuous places and running them in chases which leave them partly exposed.

The Concrete Cornice—One of the exterior features which has attracted much attention is the cornice, which is shown in the detail drawing. This feature was given much study to effect a light cornice in harmony with the work. To further lighten the effect, the soffit of the cornice is paneled. The cornice construction is readily understood from the details in the illustration, Fig. 17. It will be seen that wood brackets are hooked to the steel form and on these wood stringers are laid which support the cornice form. Panel forms are planted on top of the main form. The cornice and roof are run continuously and the gutter formed as shown in detail in Fig. 15.

Steps and Porches—It is needless to state that all porches and steps are of concrete; a color note is, however, produced hereby forming the porch steps as shown in Fig. 16, so as to take a brick on edge, giving brick treads for the finished work.

Door and Window Frames—Much study was given to proper door and window frames, which should be absolutely tight and yet capable of being easily placed in accurate position. It was decided not to attempt to place the frames directly in the forms themselves. A rough buck is used around each opening, giving a slight adjustment for accurate placing of the frames, which are set after the rough pouring is completed and made tight by corking and by exterior and interior plastering.

[The work, which was well under way with steel forms, as described in this article, was completed by the Aberthaw Construction Co., Boston, who did a part of their work with wood forms.—Editor.]

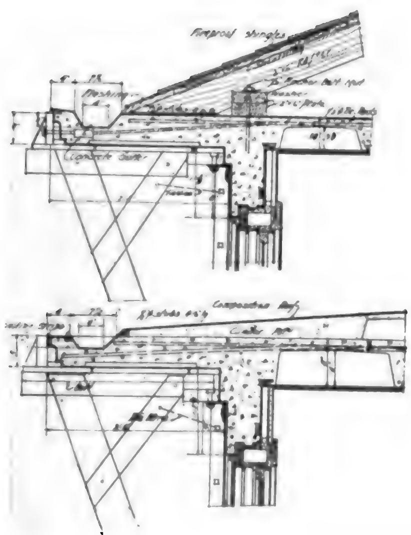


Fig. 17 — Cornice Details, Showing Form Arrangement

Note pressed steel floor cores and the way forms are tied by the reinforcing steel.

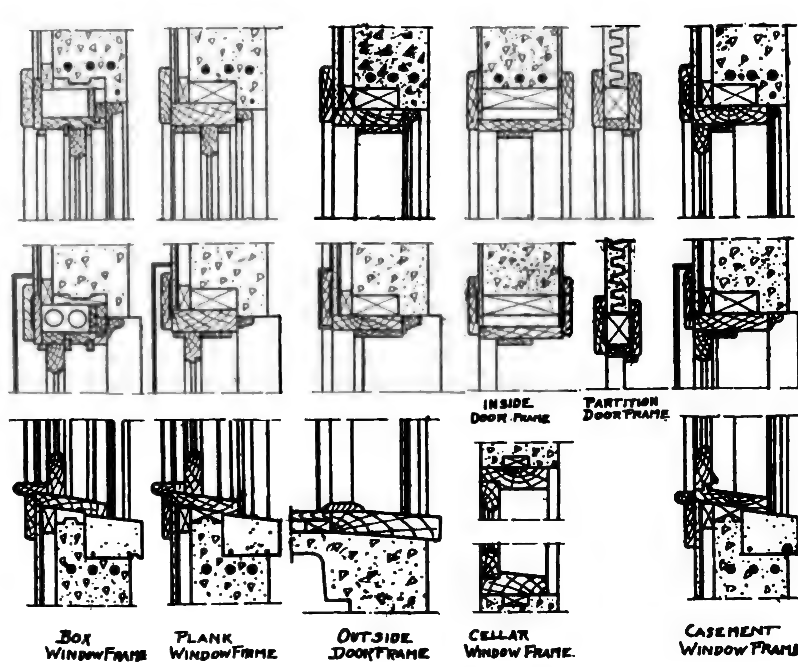


Fig. 18—Details of Window and Door Frame Construction

My Own House—How It Was Built

Plans, Construction Details, Costs of a Dwelling with Concrete Walls, Floors, Roof, Stairs[1]

By C. D. Gilbert[2]

Walls built with double wall machines, as on the following pages, have the advantage of providing continuous air space insulation without furring and giving good exterior and interior surfaces for the direct application of stucco and plaster. Houses built with such wall machines have come to be designated by their originaotrs as "thermos bottle houses."

This machine consists essentially of a box-like piece of equipment about 5 ft. long, provided with a collapsible core, and in use is placed in position on the footing; then the wall chambers are filled with concrete of just such consistency that it will not sag when the machine is released. Having filled the machine, a single movement of the lever releases it from the wall and it is instantly pushed ahead and again filled. This operation is repeated around the wall, when it is generally found that the first course has hardened sufficiently to bear the weight of the light machine and another layer can be immediately placed. Suitable provision is made for reinforcing and for placing window and door frames and for all other construction details. The walls as left by this process are rough, no attempt at finish being made during their construction. They provide, however, an ideal surface for the application of plaster and stucco.

Fig. 1—The Northwest Corner of the Gilbert House
Fig. 2—A Detail of the Front Entrance

The decision to build an all concrete house was reached after several years of close association with concrete work, during which the writer designed and built a number of houses in which concrete was used for all exterior work except roofing.

It was decided to keep in view a mental picture of the house five or ten years hence, to accept the fact that there would inevitably be a period in its raw newness when the house would stand out somewhat stark and cold by comparison with the warm color tones and softer lines assumed by its neighbors in brick and wood. I was reconciled to be for a time, if necessary, the subject of some criticism for having dared to introduce a new note into a neighborhood of "cozy homes."

The house as built is intended largely to form a background for future work. Shrubbery will soften lines that seem too uncompromising; vines will be invited to cover the larger spaces of wall and the two-storied porch overlooking the garden from its five large arches was planned essentially as a mass to be covered with vines, and with foliage trailing over its top from the garden on the roof.

Anyone inclined to criticise harshly is invited to consider the work not as it is, but as it will be under the softening ministrations of nature.

The problem was to provide an 8-room house, consisting of good-sized living and dining rooms, a kitchen large enough to be a real work room, a study or den on the first floor, and four bedrooms and bath on the second floor. An ample porch at the rear, opening on the garden, and above it a sleeping porch opening from two

[1]From Concrete, January, 1918.
[2]Associate Editor of Concrete, April, 1915, until his death in October, 1918.

bedrooms, were wanted, and for architectural reasons a fairly impressive entrance considered essential. To secure this with the amount of money that could be spent made it necessary to exclude every non-essential, to forego expensive detail, and to reduce the plan to uncomplicated lines.

To build this in fireproof construction in 1916, in a locality where gravel cost more than $2.00 per yd., and where the common labor available consisted chiefly of "bums" at 30c per hour, and still to keep within the cash limit of $6,000, required "some" calculation. That the job, including certain minor additions not originally contemplated, was actually completed, in the face of a fast rising materials market, within a $6,500 cash outlay, is largely to the credit of Frank E. Wyland, who, as foreman, took a personal interest in the success of the job, and personally did most of the carpenter and concrete work, with the assistance of a job-trained handy man. The plans and the owner's spare time are not included in the cost figure.

FIG. 3—THE CONCRETE HOOD OVER THE GRADE ENTRANCE (SEE DETAIL FIG. 12)

THE PLAN

The plan was arranged to be included in an outline approximately 32′ x 30′, and the room arrangement is shown in the accompanying illustration (Fig. 5). Special attention is called to the very complete use of the basement, which provides, in addition to the usual heating installation, much storage and working space. A hopper bottom bin under the front porch holds the coal supply and delivers it to a convenient point. A masonry wall encloses a closet specially fitted to store safely screens, storm sash, etc. There is a small store room. The main bearing wall forms a dust-proof barrier, shutting off the laundry and work room, while the space under the rear porch is a cold cellar.

CONSTRUCTION

Following the placing of footings, the wall machines were started and all walls carried to the levels of the under side of the floors, then an extra 9″ course was run on the outer section of the double wall (Fig. 13). Against this 4″ wall 8″ planks were set on edge, wedged away from it ½″ and carefully leveled. These planks served the double purpose of covering the air space and continuing it to the top of the floor, and as a screed for leveling.

Skeleton floor forms were placed consisting of five lines of 2″ x 8″ bearers on each side of the center wall, supported by shores about 5′ o. c. On top of these bearers 10″ planks were laid from wall to wall to form beam bottoms. The 6″ clay tile were then placed, and the steel followed.

REINFORCING

Most beams were of approximately 14′ span, 16″ o. c., and were reinforced with two ½″ bars, one being bent up. The bent-up bars were well lapped over the center wall to take up negative stresses.

Temperature stresses were provided for by ¼″ rods 18″ o. c. crossing the beam steel. The walls were reinforced by ¼″ rods placed in the centers of each wall at floor level and above and below windows. Window lintels are wall sections placed with especial care and properly reinforced. The wall ties were No. 6 gal. wire, hooked at each end and used about one tie to each sq. ft. of wall. Corners, the chimney, etc., were reinforced with No. 6 wire and ¼″ rods, as seemed desirable.

CONCRETE

Concrete consisted of screened and washed sand and gravel mixed at the pit and locally known as 60-40, referring to the proportions of gravel and sand. Walls consisted of a 1:6 mix and reinforced floors of a 1:5 mix, with 10% hydrated lime.

The consistency of the concrete used in walls was such that when tamped water would be flushed to the surface and water ridges appear on the machines being released. Concrete for floors was used mushy, but with no excess water. The concrete was mixed and hoisted with a Jaeger mixer, equipped with loader and hoist.

Above the first floor it was handled in wheelbarrows and buckets on an elevator running in an outside tower.

The concrete for the first floor was placed by wheeling it up an incline. With that floor in place, its top and the outer walls were substantially level, while the floor was carried entirely by the inner wall. The plank screeds were removed and the walls continued upward. The second floor was placed in the same way, and the elevator made the labor cost for the second floor concrete less than that of the first floor.

FIG. 4—THE SOUTHWEST CORNER

Note the chimney and a glimpse of the two-story back porch; also the concrete hot bed in the sheltered corner.

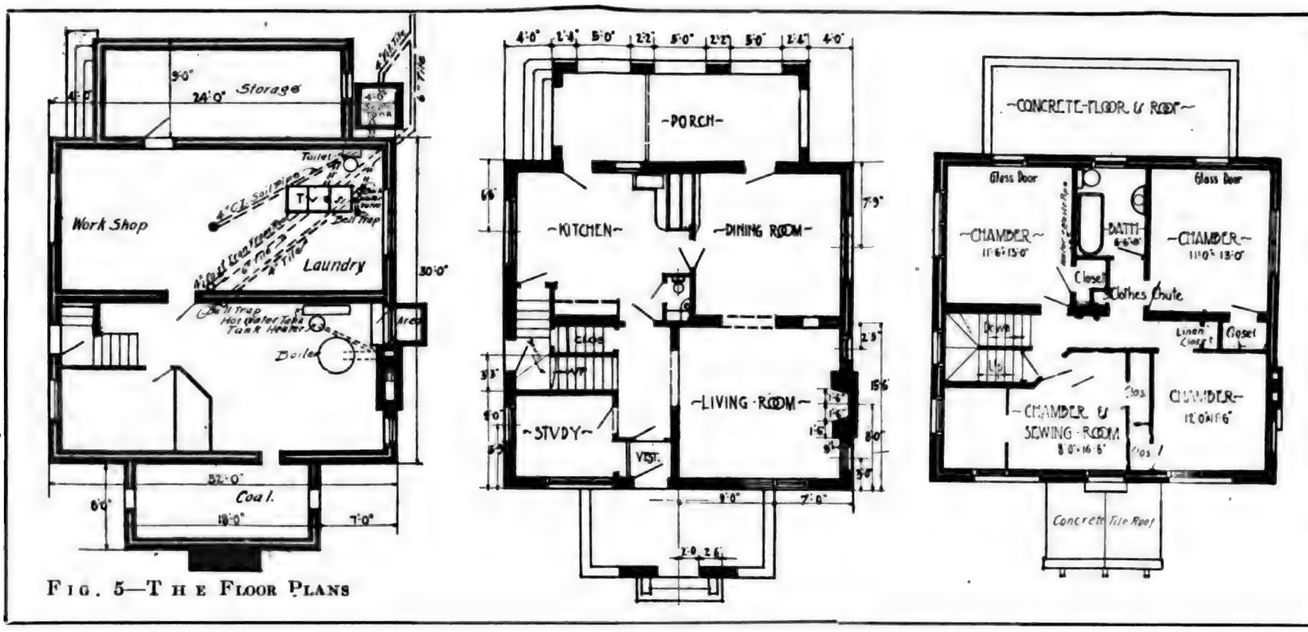


FIG. 5—THE FLOOR PLANS

The roof and cornice presented the most difficult problem, since the supply of form lumber was limited and it was undesirable to purchase more.

The cornice overhang is 3′ 9″; its construction is similar to the floors; it has a 6″ beam around the edge. Shoring from the ground would have required much lumber, and it was decided to support part of the roof and the cornice forms on the walls. This was done by coring openings in the last course of concrete at points where bearer lines came, and projecting the bearers through the walls, forming cantilevers on two sides of the house. On the other two sides cantilever beams were balanced on the wall and were carried back to the first line of bearers about 4′ from the wall. Cornice forms were built up on these outriggers as shown in Figs. 13 and 15. The soffit of the cornice was recessed 1¾″ to allow for plaster and a drip, and to secure a better appearance. This method of form building not only eliminated all outside shores, except for one at each corner, but it greatly reduced the number used inside the building. The pitch of the roof toward the center from the cornice edge is 6″ and was provided for in building the forms.

In placing the concrete for the roof, care was taken to have it deposited inside the walls in an amount equal to that contained in the cornice before placing the cornice, and no appreciable deflection of the cornice forms was noted.

The day following the completion of the roof slab a mortar coat averaging 1″ thick was applied to the carefully cleaned and wet slab, and in spite of the fact that it was a hot, windy day, and that the mortar checked before it could be covered with water, there has as yet been no sign of leakage. As soon as the mortar coat was in place, the sump was plugged and the roof basin kept filled with water for 10 days.

THE PORCHES

The porch floors are flat slabs 5″ thick, reinforced with ½″ rods transversely, 9″ o. c., and with ¼″ temperature rods longitudinally.

The front porch wall is double to the rail level; above that the wall is solid, with a concrete coping. The porch roof is frame, carried by hewed 8″ x 8″ beams secured from an old building, and is covered with red concrete tile. The ceiling is metal lath and plaster.

The back porch consists of double walls to the level of the first floor rail. Above this the piers are solid, 8″ thick. The second floor is supported on light concrete beams between piers. The roof slab over the second floor porch is surmounted by a light, solid wall and is covered with 18″ of earth to be planted with flowers and vines, which will trail down over the walls (Fig. 12). The balustrade of the second floor porch is formed of ribbed metal lath set in the pier forms and embedded, then plastered. It has a light cast cap and a deeply recessed panel, as seen from the outside. The coping above the main roof is the same as the house walls and is capped with concrete and relieved with brick inserts at the corners.

DETAILS

Chimneys—The main chimney was cast as the walls were built, by the simple method of setting a vertical plank on each side of the double wall and using two plank panels which were clamped in place by long bolts and raised as required. The main chimney carries an 8″ by 12″ heater flue and 12″ x 12″ fireplace flue (Figs. 9 and 13). A small flue lining set entirely within the wall forms the ventilating duct from the kitchen.

Entrance Hood—Over the side door is an ornamental hood (Figs. 3 and 12), which was cast in place in a wood and metal form made on the ground and set in place after the walls were up. The concrete hood is securely tied by steel bars through the wall, and the brackets are cast in chases left for them.

Fireplace—The fireplace was cast in wood forms with the regular concrete mix, with the exception that a quantity of screened pebbles, from ¼″ to ⅜″, were added. Concrete of this mix was placed to the level of the mantel. The mantel itself was cast of a rich, fine mix designed to be rubbed. Forms were taken away from the fireplace within 12 hours, and the face scrubbed with a stiff brush under a stream of water, leaving the stone aggregate prominent. When hard, the mantel shelf was rubbed with a carborundum stone and water to a perfectly smooth surface. Small decorative tile of dull green and blue shades were set in the fireplace panel with mortar that, when washed, presented the same appearance as the rest of the work. The hearth is bordered with smooth, red brick.

Stairs—The cellar stairs are of concrete without nosing, reinforced and laid on earth fill. Reinforcing steel

FIG. 6—THE BASEMENT NEARLY COMPLETE

The dark courses are the work done the day the pictures were taken.

FIG. 7—STARTING A NEW COURSE

Note the angle iron corners, which keep the lines true.

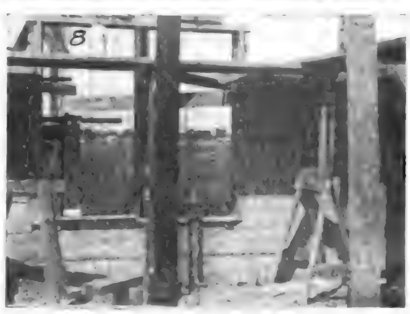


FIG. 8—DETAIL OF WINDOW FRAMES AND SCAFFOLD

The scaffold horses and extensions are each 3′ high and are ample for ordinary story heights.

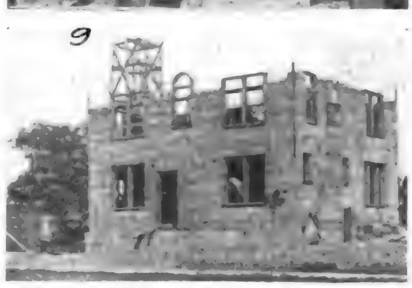


FIG. 9—JOB WELL UNDER WAY

Note the corner irons raised. They are secured by wires built into the wall. Note how window frames are set high, so sills can later be filled in under them. Note, too, the lines of flashing built in for the porch roof.

FIG. 10—CORNICE FORMS DOWN, ABOUT READY FOR STUCCO

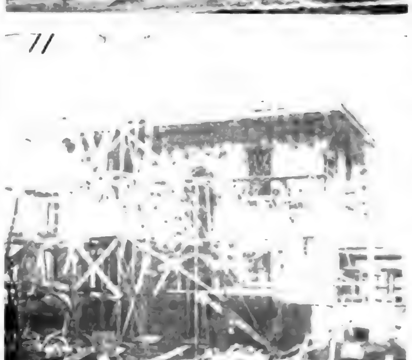


FIG. 11—PUTTING ON STUCCO

Note the easily moved scaffold; also the location of mixer and tower.

for the main stairs was placed in position before the floors were poured, and also anchored into suitable depressions in the walls. Steel for the landings was wired to the steel of the flights, and when the floors were complete, forms were built under the stair steel to form the soffit.

The main stairs (Figs. 12 and 17) consist of treads made by laying a very smooth, hard burned brick flat on top of a 2″ riser form. The riser was shorter by the thickness of the brick than the height of the stair rise, and concrete was filled level with the riser top. The brick were then set and show a wide mortar joint and a border about 3″ wide at the back and the ends of the step. When the forms were removed the riser and walls were finished with a sanitary cove, so that there are no sharp corners in the stair. Because of the restricted space, the stair rail, which is continuous with the closet partition below, is of plaster 2″ thick on Hy-rib. The newel post and rail were cast about the metal lath and are of terrazzo. A flight of concrete stairs with simple nosings worked on them lead from the second floor to the roof. Electric light and water connections are provided on the roof.

Partitions—The main bearing partition is of double wall, 13″ thick, including plaster, and the partition enclosing the stairway is of solid concrete (6″ thick), but the minor partitions are varied in construction. The more important ones are of 6″ tile, which were left from the carload purchased for floors and roof, while closet partitions on the second floor are of frame, in order to utilize some of the lumber on hand. The second floor ceiling is of lath and plaster on wood overlays, and provides an air space for insulation under the roof slab.

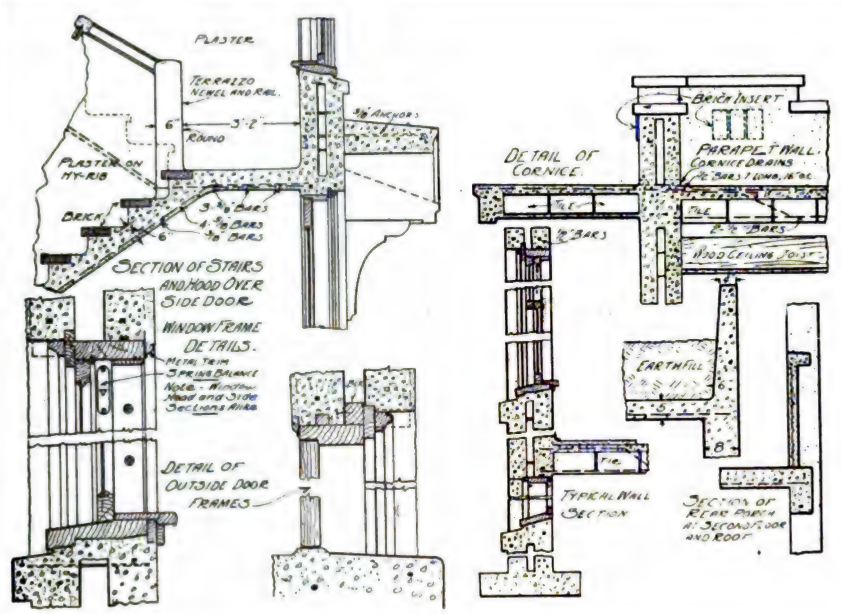
Plastering—The plastering was done with mortar, consisting of hydrated lime, cement and sand, of proportions varying somewhat according to the rooms in which used. All rooms except the kitchen and bath, which are smooth, were left in a very rough sand finish from a wooden float, and in the principal rooms the walls are coved into the ceiling. Arises were kept true and wall surfaces reasonably flat, but any attempt at extreme finish was avoided. In some rooms mortar colors were added to the mix, and while the result was not an entire success, due to bad drying conditions, the amount of paint needed to cover the walls was greatly reduced.

Finish Floors—The plaster coat was carried to the rough floor and when plastering was complete the rough floors were thoroughly cleaned and soaked and the finish floor laid to the top of a 7/8″ screed, leveled up to clear the high points, giving an average thickness of slightly over 1″.

The method used for laying the finish floors was to lay down screeds about 2′ from the walls of the room and to fill the space between the screed and the wall, at the same time turning the mortar coat up the wall to form a smooth base, finished against the plaster wall and about 3″ thick. The floor was leveled by working a long straight-edge across the screeds, depending upon them to level the 2′ border accurately. After the border was placed it was a simple matter to fill the field, which was done as soon as the border had set sufficiently to act as a guide for the straight-edge.

The concrete floors were treated with a liquid hardener, to prevent annoyance from dusting.

A local scarcity of sand, at the time the work was done, prevented the use of the ideal mixture. It was necessary to use a very coarse, almost gravel mix, to approximately the floor level, and to use a very light coat of fine mortar placed immediately following the laying of the coarser material, and thoroughly worked into



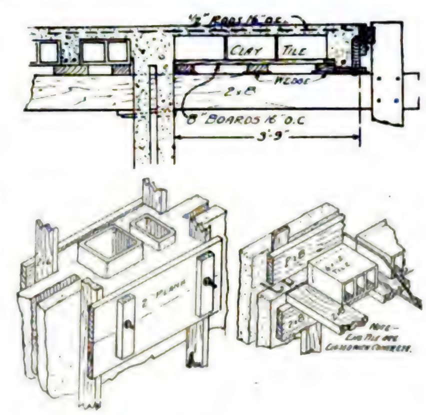


FIG. 12 — SOME CONSTRUCTION DETAILS

FIG. 13—DETAILS OF FORMS FOR FLOORS, CORNICE AND CHIMNEY

FIG. 14 — HOW COPING FORMS WERE SUPPORTED

Supports "A" were built into the wall in a joint.

FIG. 15 — THE CORNICE FORMS

Note that shoring is used at corners only.

it, to form the smooth surface. The base mix was 1:3½ and the fine top mix 1:2, with about 10% of hydrated lime. This has given a pleasing gray color, which forms an excellent background for floor coverings.

The kitchen and laundry floors are painted with a cement paint to facilitate cleaning. The bath and lavatory floors are of tile.

THE STUCCO

It is the general impression that to stucco a rough concrete surface is very expensive, but the use of proper methods does much to make the cost reasonable. The finish desired was a moderately rough texture, with a gray rather than white color. The mix was 1:3 cement and sand, with the addition of about 20% hydrated lime, which produced a very easy working mortar of desired strength and color. The stucco was applied as follows (Fig. 11):

Scaffold—Two horses were built, 18′ in height, which enabled the soffit of the cornice to be reached and bearings were provided on them at 6′ intervals for staging plank. These horses, in connection with a couple of upright poles and ledgers at the windows, were all the staging required to carry the planks, and were very rapidly and easily handled. When starting a side the wall was thoroughly soaked and a few minutes were spent in applying dabs of mortar here and there where, for some reason or another, the surface needed a filling greater than could be given by one coat of mortar. Straight planks were set at each corner to form plastering screeds. A moderately thick coat of mortar was then found to be sufficient to true the surface, and could be applied to the rough textured surface very rapidly. The cornice was first plastered and because of the different suction in the concrete and the clay tile, this was done in two coats, in order to prevent difference in color. The walls were, however, straightened with a single coat, over which a dash was applied.

The mortar was laid by one man, including roughly plastering reveals to window and door openings. Immediately behind him the finisher darbied the surface true and with a short straight-edge to guide him and a wood float, brought the edges of openings to true corners. This can be done very rapidly and accurately and at much less cost than by fitting screeds into each opening, as is sometimes done. The method used prevents the formation of cracks that are often found where window reveals are plastered after the mortar of the wall has been allowed to set partly under a screed.

As soon as a side was completed, before removing the scaffold, a dash was applied consisting of 1 hydrated lime, 2 cement, 2 sand and 3 pebbles, passing a ¼″ screen and collected on a ⅛″ screen. The cost of materials and labor for stucco was approximately 45c per

FIG. 16 — THE CONCRETE FIREPLACE

sq. yd. The stucco was machine mixed, which enabled one man to tend two plasterers.

Interior Trim—The interior trim is chiefly of oak, except that all doors and window casings are metal.[8] The door jambs were set before plastering and protected with building paper.

The casings of all openings consists of a hollow sheet metal molding,[8] costing about 5c per ft. and applied in approximately the same time as wood window and door trim. The metal is readily cut with a hack saw in a mitre box, and the mitre cut by a few taps of the hammer coped against the member which it joins. The trim is all in place before plastering, and filled in by the mortar, forming a rigid and perfectly molded edge. Window stools are fitted around the metal trim, which is either painted the same as the plaster of the wall or in a contrasting color, as desired.

Costs

Exact cost keeping on a small job, without an office organization behind it, is notoriously difficult. The costs given here are from carefully kept records of labor, while material costs have been apportioned as exactly as possible. No charge has been made to cover overhead or depreciation, except as noted. The costs given deal in detail only with concrete work. Charges for lumber are admittedly arbitrary and unexact, since most of the form lumber was repeatedly used in various ways, and a considerable amount finally salvaged and used for minor partitions, ceiling joists, etc., and some remains on hand. Probably only about half of the rough lumber bill should be directly charged to concrete work.

Equipment

Since the work was to be done on force account, it was necessary to purchase new equipment. The principal items were:

A Big-an-Little mixer, with loader and material hoist, including freight to Detroit	$387.00
One set of double wall machines, including freight	204.00
4 pcs. 2½ angle iron, to use on wall corners	9.00
3 12" sheaves, with pins	5.70
90' of ½" plow steel cable	8.82
1½ doz. gal. concrete buckets	9.38
3 sq. pt. Conneaut shovels	2.69
2 rd. pt. Conneaut shovels	1.76
1 long handled shovel, round pt	.85
1 pick	.75
1 wrecking bar	.75
1 crowbar	.75
4 wheelbarrows	18.00
1 bolt clipper	1.50
Total	$650.95

Sixteen 3' scaffold horses and their 3' extensions were built at a labor cost of $8.60—material is included in lumber bill.

It is difficult to place a depreciation charge on equipment and lumber, since much depends on future disposition of it, but a tentative charge of $275 would seem ample to cover tools and rough lumber not actually utilized later at full value.

Bill of Rough Lumber Purchased

Shiplap	1870	ft. B. M.	$39.70
1 x 4	408	"	12.26
1 x 6	400	"	11.20
2 x 4	1388	"	40.94
2 x 6	684	"	28.20
2 x 8	2111	"	62.37
2 x10	933	"	27.99
6 bundles of wood lath			2.70
3 bundles of shingles			3.40
2 x 2			3.50
Total			$224.46

Steel

Reinforcing steel was purchased for a lump sum and cost delivered to job $210.00 in addition, to which 500 lbs. of No. 7 galvanized wire was used, principally for wall ties, and cost $30.00.

Labor

Detroit felt the labor shortage in 1916 more than most localities. The good men were employed, and it was practically impossible to pick up a temporary force of either laborers or mechanics.

Fig. 17 — The Brick Stairs and One of the Living Room Arches

The foreman, who is a thorough mechanic in wood, concrete and plaster, received $7.00 per day. One American, without experience, but willing to learn, operated the wall machines and later was general "handy man" at 35c per hour. The one good laborer secured was paid 30c and later 35c, and other laborers—"bums" picked up from day to day—received 30c per hour. The writer was able to put in an occasional day at times of need, mainly on form work, and time was charged at 60c per hour for such work.

How Labor Costs Were Kept

Labor costs were kept by the foreman on a ruled sheet of cardboard bearing the names of workmen at the left, with the rate of pay. A series of columns was headed with the different kinds of work being done for the week, represented by the sheet, and each man's time entered each night. It was a simple matter to arrive later at labor costs for each item by a summary of the job sheets.

While not absolutely accurate, the system is simple and will serve for most small jobs.

Material charges are approximate, based on a daily record of cement consumption, and checked by a summary of sand and gravel bills.

Five cars of gravel were received, graded for use with the proper amount of sand. It was teamed two miles over concrete roads, and cost approximately $2.15 per yd. at the job. Nearly another car of gravel was purchased locally and averaged $2.50 per yd. Some sand for stucco and plaster was bought at $2.50 per yd., but a local sand famine made it necessary to pay $3.50 per yd. for about 25 yds. to complete the work.

Cement was bought (345 bbls.) early in 1916 and cost on the job $1.80. About 30 bbls. were bought later locally at a higher price.

Concrete for walls was mixed 1:6; for floors, 1:5 with 10% hydrated lime. All concrete is assumed to have cost $4.15 per cu. yd. for materials on the job.

Summary of Costs of Concrete Work

Based on the foregoing prices and conditions, the following costs relating directly to concrete work have been compiled:

Cost of Double 4" Walls

The double 4" walls cost, rough, $936.22, or $0.1835 per sq. ft., for concrete and labor as follows:

There are 5,100 sq. ft. of wall area super., with which is included the 250 ft. of 5" solid wall of stair partition. Net area, all openings deducted 4,484 sq. ft.

The concrete volume is 122.5 cu. yds. Material cost (except steel and ties), $507.37. Labor cost, $428.85. Total, $936.22. Unit costs: Per cu. yd. of concrete in wall, $7.77; per sq. ft. super., $0.1835 per sq. ft., net 21c. Reinforcing steel and wire ties add approximately 1c per sq. ft. super. Stucco cost $0.045 per sq. ft. super.

Cost of Floors

Basement Floor—The basement floor is 2" thick. There are 998 sq. ft., or 7½ yds., concrete, costing $31.12. Labor to place, $38.45. Total, $69.57—approximately 7c per sq. ft.

First Floor—Total cost of first floor, $212.68, or $0.253 per sq. ft., divided as follows:

Materials—	
10¼ cu. yds. concrete	$43.58
600 6" clay tile at 8.5c each	58.10
Steel (apportioned approx.)	55.00
Form lumber (charge est.)	10.00
Total materials cost	$151.68
Labor—	
Building forms, tile and steel placing, and wrecking	$28.20
Placing concrete	32.40
Total labor	$60.60

Second Floor—The cost of the second floor was $224.03, or $0.29 per sq. ft., made up as follows:

Area, 840 sq. ft.—	
Materials (as for first floor)	$151.78
Labor (cleaning forms, splicing shores, setting forms, tile and steel)	41.95
Placing concrete (elevator in use reduced this item)	20.40
Total (29c per sq. ft.)	$224.03

THE ROOF SLAB

Roof Slab—The cost of the roof and cornice was $497.86, or $0.39 per sq. ft., made up as follows:

Area, 1,300 sq. ft. Material—	
22 cu. yds. concrete	$91.30
1,100 clay tile	97.35
Steel	90.00
Lumber—charge	20.00
6 yds. mortar at $6.00 per cu. yd	24.00
Total material	$322.65
Labor on forms (including cleaning and wrecking)—	
Tile and steel	$106.58
Labor on concrete	68.63
Total	$497.86

Porch Floors—The 5" porch floor slabs cost $117.08, or $0.172 per sq. ft., divided as follows:

The front porch floor, two back porch floors, and roof slab total 680 sq. ft.

There were used 10¼ cu. yds. of concrete	$41.50
The lumber, steel and mortar top are estimated as	20.00
Labor cost for forms and concrete	55.58
Total labor and material	$117.08

LABOR COSTS OF DETAILS—The cost of small details is so largely in labor, and the yardage of concrete so small, that the following notes may be of interest:

THE CHIMNEY

The chimney was built along with the wall, and an amount equal to the wall area displaced is included in wall costs. It is estimated that 3½ cu. yds. of concrete and $20.00 labor represent the extra cost of chimney, exclusive of flue lining and special work on fireplace.

FIREPLACE

The fireplace forms were built by the writer and hte finishing was done by him. Exact time not kept, but $15.00 should about cover.

STUCCO

There are 412 yds. of stucco applied. Material $60.00, labor $125.58; total, $185.58, or 45c per sq. yd. (This does not include the back porch, which will be finished by the writer personally to his individual ideas. Its estimated cost is, however, included in the total cost figure given earlier in this article.)

STAIRS

There are estimated to be about 7 yds. of concrete in all stairs. The labor cost was:

Cellar stairs (no nosing and including landing placed on earth fill reinforced)	$20.80
Stairs to second floor (brick steps—Fig. 12—terrazzo post and rail)	42.30
Stairs to roof (concrete, with nosing)	31.70
Steps of front porch	8.40
Steps of rear porch	5.25
Total	$108.45

MISCELLANEOUS

Building and rigging construction tower and elevator	$21.80
Septic tank (single chamber, not including excavation)	26.90
Placing forms and finishing hood over grade door	7.60
Setting window and outside door frames	51.30
Placing window and door exterior molding	9.65
Concrete window sills	18.28
Concrete door sills	4.65
Total	$140.18

FINISH FLOORS

Labor and material for concrete finish floors and base cost approximately 10c per sq. ft.

50 Double Wall Houses for Carnegie Employees[1]

Fifty five-and six-room houses, with double, 4" concrete walls, are being built by the Carnegie Steel Co., close by its Steelton plant, Youngstown, Ohio. [Since this article was published, in 1919, the completed work was found so satisfactory as to warrant the construction of a still larger number of houses of the same type of construction for Carnegie employees.—Editor.]

Ground was broken August 30. The first concrete footing was poured September 6. Rains, inclement weather, and holidays held up construction for 25 days, yet when the concrete work was stopped for the winter, November 26, the walls of 25 houses were up and a start made on 10 others.

This work was handled under most interesting conditions from the concrete man's standpoint. An appropriation for the work was made by the Carnegie Steel Co. July 25. Previous housing work had been chiefly in frame construction, and plans and specifications for frame houses were given to contractors August 5. Bids were received from various contracting companies August 19 for frame houses, and all bids were rejected on account of high cost. In the meantime, one Van Guilder type double wall concrete house had been built near one of the Carnegie plants, and on the basis of that experimental house the type of the new house group was changed by the company officials from frame to concrete. It was decided to build the houses with the steel company's own organization, under J. H. Grose, district superintendent. A contract was let to the Van Guilder Double Wall Co., Rochester, N. Y., covering merely the labor on the foundations, walls and footings, using double wall machines in the work.

The plans are practically identical for each size, yet are reversed for variety, and some built with the short dimension facing the street and on others broad side to the front. There is also a considerable variety in roofs and in porches and entrance detail, as shown by the accompanying illustrations from detailed drawings.

The walls of the structures are two 4" walls with a 2½" air space between. Brick work has been entirely

[1]From CONCRETE, Jan., 1919.

eliminated. The flue lining is carried up to the top of the chimney in concrete. All concrete in walls has been placed by ordinary labor, with the exception of one machine operator in each of six crews of eight to nine men each.

Herewith is presented the estimated cost of these houses, as made by the Carnegie Steel Co. organization. The figures have all been checked with the contracts let. These contracts include excavation, concrete walls and footings, plastering and stucco, roofing and sheet metal

FIG. 1—PROGRESS VIEW (DEC. 19) OF VAN GUILDER SYSTEM HOUSES FOR CARNEGIE STEEL CO., YOUNGSTOWN, OHIO

work, painting, wiring, plumbing, heating. Carpenter work is being done under Carnegie supervision, and will be below the estimate given. Masonry work is by the Carnegie Steel Co. organization also. It will be noted that the total cost of a 6-room house appears in the estimate as $3,759.64; the total cost of a 5-room house as $3,550.00.

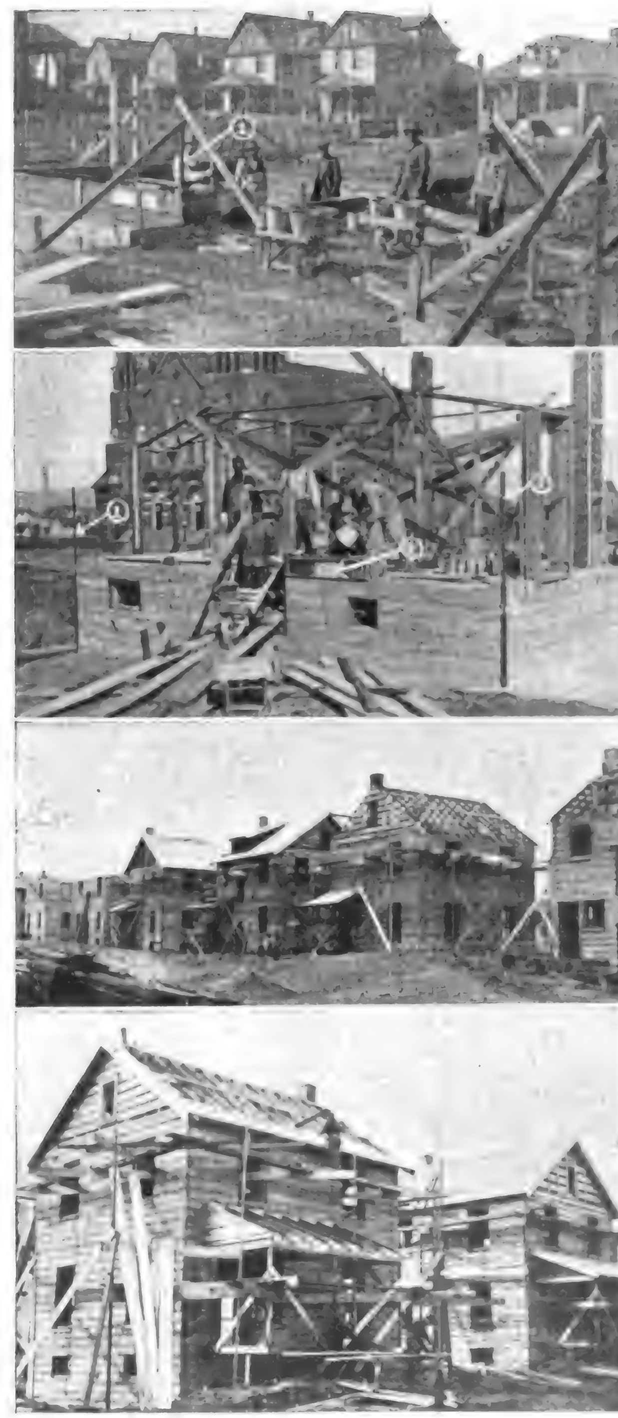
The work on these houses has been standardized to a very great extent. There is an economical and uniform bathroom layout; minimum amount of labor and material used. Staircases are all framed in the mill and will fit any house, either of 5 or 6 rooms. There is a built-in kitchen equipment the same for each of the various types of houses. One dimension of every house in the group is the same.

By way of comparison it is interesting to consider the Carnegie company's tabulation of the estimate sheet on the original frame house proposition. There were nine bidders and six separate types of houses bid on. The average cost of the six types of houses under the highest bidder would have been $4,576. The low average was $4,104. The average of all the bids on all the houses was $4,382. It was these bids for frame construction which led the company officials to change to concrete, with the result that six-room houses are to be built for $3,759 and five-room houses for $3,550. It must be borne in mind that while these total costs are referred to as estimates, they are actually based on absolute contract figures as noted in Table 1, and on estimates of force account items, the largest of which—carpenter—is coming under the estimate.

Outside walls are of two-coat stucco. Floors and roofs, the latter covered with asbestos cement shingles,[2] are of frame. Plaster, furring being unnecessary, is applied direct on the inside of the double walls.

The concrete used on this work was particularly commented on by Dr. E. M. Santee, who is in charge of the work of concreting for the Van Guilder Double Wall Co. He said he never used a mixture which worked better in a wall machine, and stood up better when the machine was removed and shoved along the wall, then this mix, which was composed of 1 part cement[3], 1 part slag sand, 1 part river sand, and 4 parts slag, using the Carnegie Steel Co.'s slag. The aggregate ran from 1″ down. The concrete work has been done under the most disadvantageous conditions, particularly as to labor. Concrete work was started September 6, Dr. Santee bringing to the job eight Van Guilder machine operators. Dr. Santee's own comment on the labor situation is as follows:

"When I attempted to get men in Youngstown it was floaters, boozers, and pensioners principally. I have had, all told, 118 men on the job, and have culled a force



FIGS. 2-5—CONSTRUCTION VIEWS, DOUBLE WALL HOUSES AT YOUNGSTOWN

The equipment used is exceedingly simple—six wall machines (one of them shown at 2), in which two 4″ walls, 9″ high and about 5′ long, are molded at one operation. At 1 is shown the angle iron braced at corners, by which true lines are maintained.

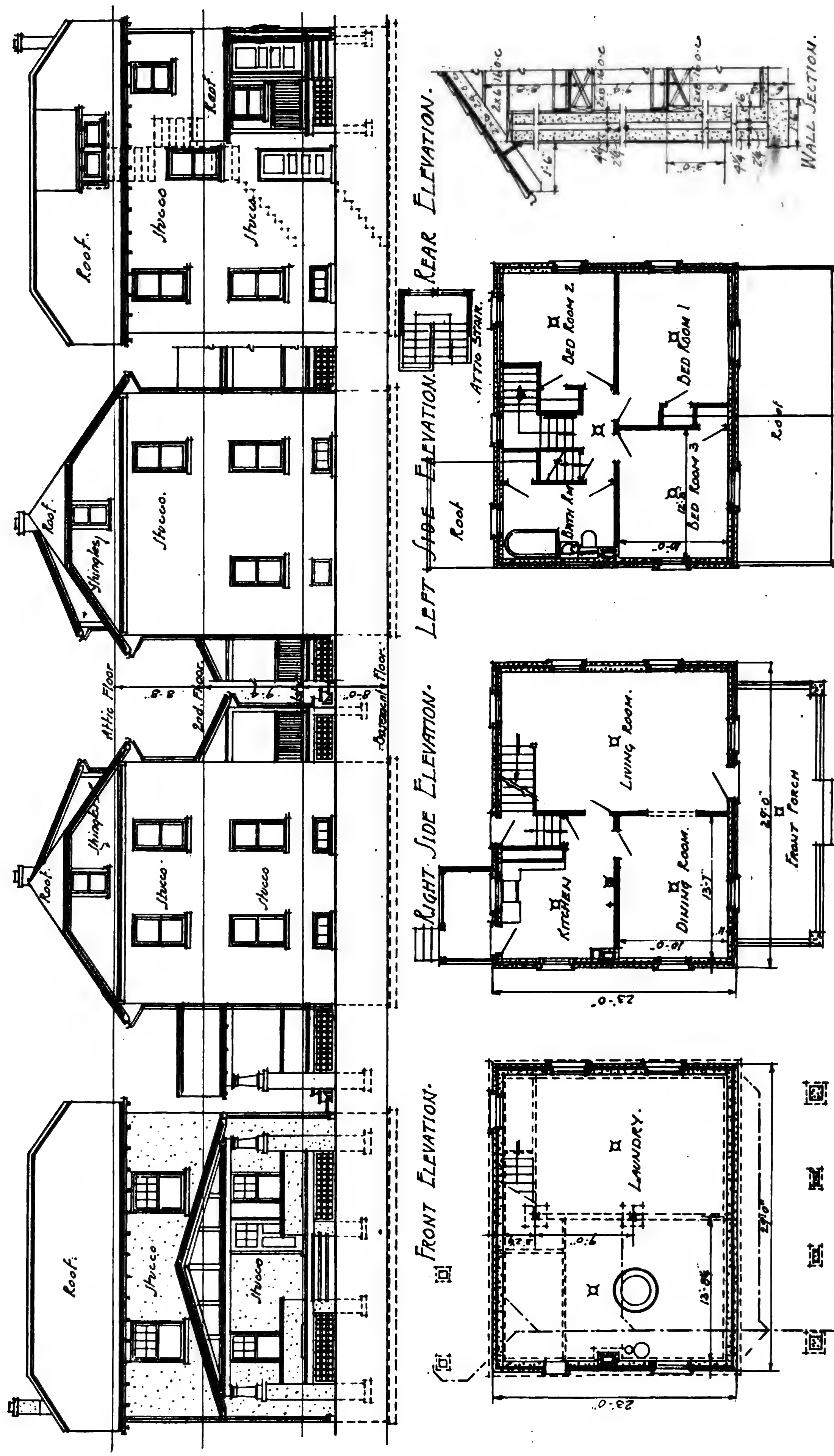


Fig. 6—Details of Typical Six-Room House, Carnegie Steel Co. Group, Youngstown

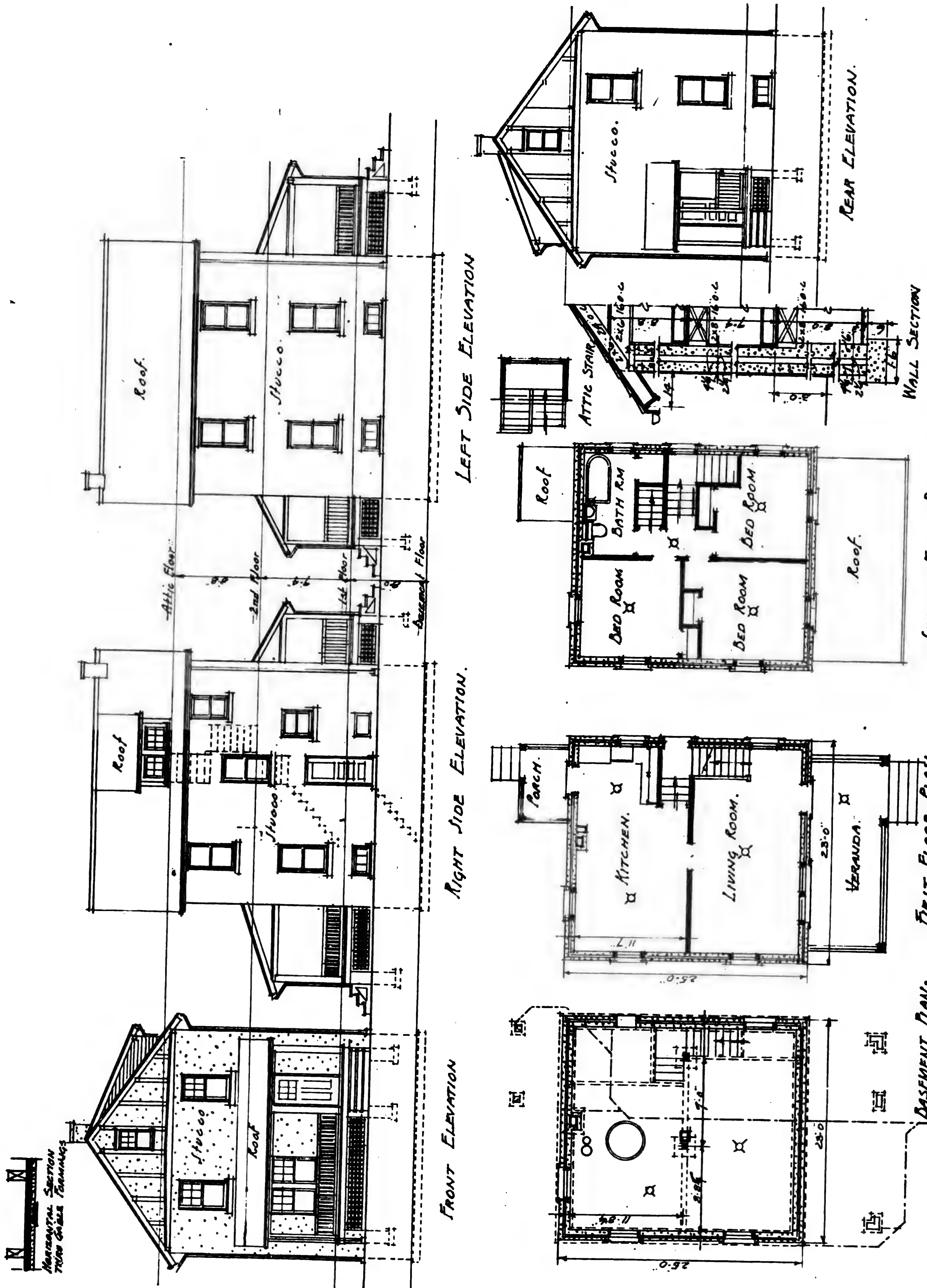


Fig. 7—Details Typical Five-Room House in Group for Carnegie Steel Co., Youngstown

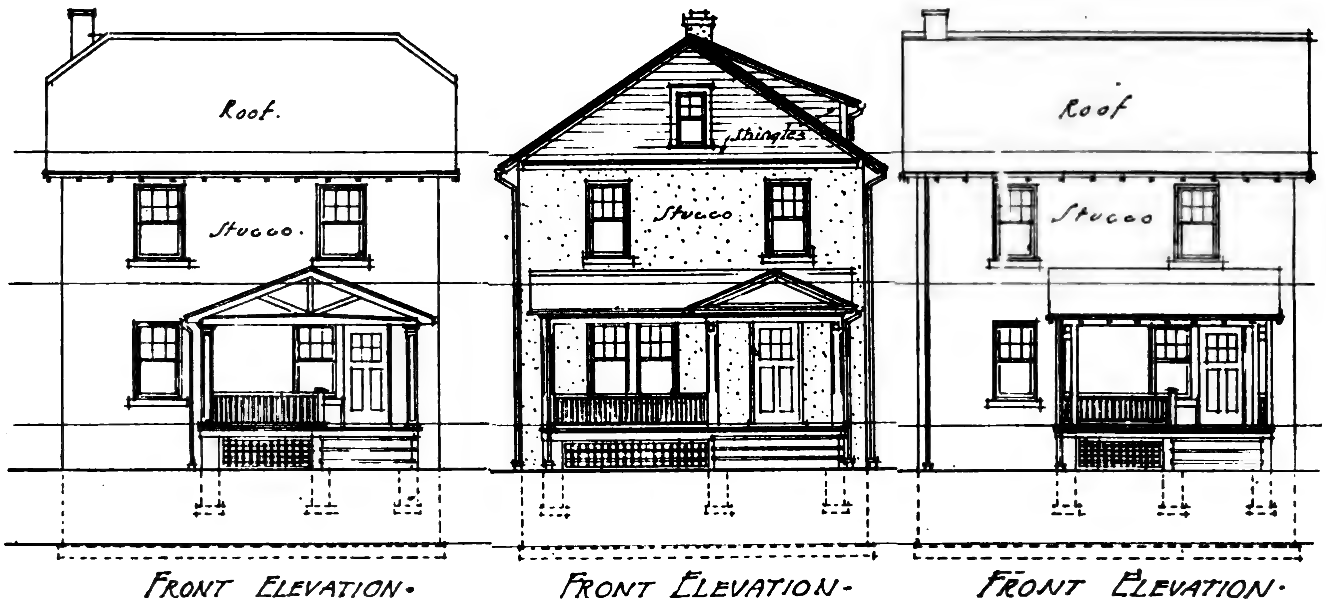


FIG. 8—SOME ALTERNATE ELEVATIONS OF CARNEGIE HOUSES

of 22 that I have never had surpassed. I was at no time able to put on eight crews, as originally intended, but have had six crews do more work than was planned originally for eight. We paid off every Saturday and never succeeded in getting more than half the men back Monday morning."

Equipment used is not extensive. Four Jaeger mixers[4] were employed. Each of the six crews, which was the maximum working at one time, consisted of eight men while the work was going on at the first story, and nine men in a crew when it had been raised to the second story level. Concrete was carried in pails, four pails to a wheelbarrow, on runways, but passed up by hand to the higher levels. In order to speed up the work, Dr. Santee offered a bonus of 50 cents a course for each course in excess of four courses put in by a crew in a day. The record made was nine courses in a single day. It was possible to put in only two or three courses on one house, and then go to the next one. Sixteen houses were kept under construction in this way at one time. The last of the concrete for the season was put in November 26. It was necessary to pay common labor as high as $4.00 and $5.00 a day. Occasionally $7.00 machine operators were used to wheel concrete. The operations and progress are shown in the accompanying illustrations from photographs.

TABLE 1—ESTIMATED COST

Permits, laying out house	$ 4.00
Excavation, backfill, grading	110.00
Temporary buildings	10.00
Insurance on labor	20.00
Supervision—timekeeping	70.00
Use of mill at McDonald	8.00
Masonry	100.00
Van Guilder labor contract	496.64
Material—cement, slag, sand	360.00
Trucking from McDonald	60.00
Plastering and stucco	480.00
Hardware	60.00
Roofing and sheet metal work	214.00
Carpenter labor	400.00
Painting (labor)	95.00
Painting (material)	25.00
Wiring	47.00
Plumbing	365.00
Heating	150.00
Carpenter material	785.00
Total cost of six-room house	$3,759.64
Total cost of five-room house, by allowing $200 for difference in size	3,550.00

TABLE 2—TABULATION OF BIDS RECEIVED ON FRAME HOUSES

House Plan—	1001	1002	1003	1004	1005	1006
No. 1 Bidder	$4,210	$4,208	$4,294	$4,626	$4,661	$4,651
No. 2 Bidder	3,826	3,899	4,005	4,281	4,878	4,298
No. 3 Bidder	4,195	4,062	4,272	4,625	4,652	4,647
No. 4 Bidder	3,938	3,842	4,671	4,894	5,312	5,301
No. 5 Bidder	4,116	4,100	4,148	4,529	4,571	4,564
No. 6 Bidder	4,155	4,129	4,176	4,668	4,432	4,602
No. 7 Bidder	4,103	4,097	4,160	4,537	4,613	4,589
No. 8 Bidder	4,165	4,218	4,372	4,731	4,987	4,797
No. 9 Bidder	3,971	4,230	4,162	4,492	4,554	4,538

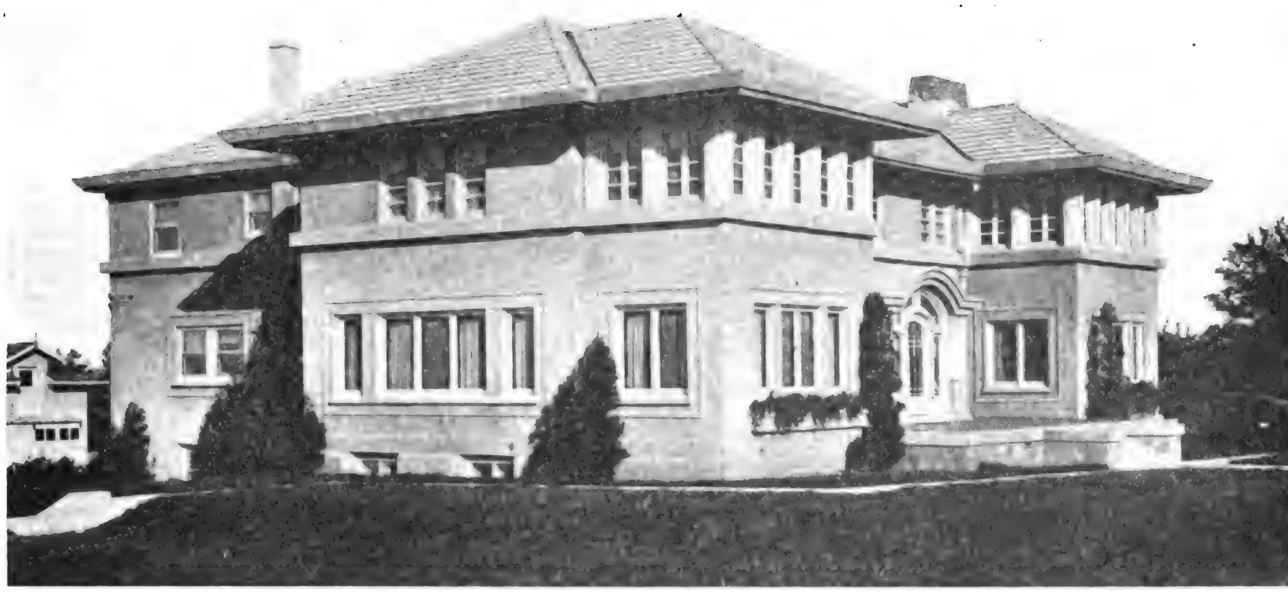


FIG. 1—RESIDENCE OF F. L. WILLIAMSON AT KANSAS CITY, MO., WALLS, FLOORS, AND STAIRS OF CONCRETE, THE WALLS CONSTRUCTED WITH A DOUBLE WALL MACHINE

An Example of Fireproof Residence Construction at Kansas City, Mo.[1]

The subject of this article is the residence of F. L. Williamson.[2] It was inevitable that Mr. Williamson's close contact with the cement industry should have impressed upon him the value of concrete as a residence material. The plans are by Shepard and Belcher, architects, Kansas City, and the concrete structural features were designed by the Trussed Concrete Steel Co.,[3] which furnished the reinforcing material.

Study of the plans shows the house to be 68′ wide and 63′ deep. The basement is fully utilized, containing a fireproof garage, man's room, laundry and work room, besides space for the heating plant and for general storage. A reinforced concrete cistern occupies the entire space under the front porch. The feature of the first floor is the large living room, with its heavy beamed ceiling.

The first floor also contains a library, dining room, kitchen and two spacious porches. The second floor provides two large sleeping porches in addition to sleeping rooms.

CONSTRUCTION DETAILS

It is obvious that in a building of this kind details must be very carefully planned in advance or considerable annoyance will occur. All electric wiring was located in conduits which were placed before pouring the slabs and walls. Chases were left for vertical pipes and conduits and such pipes as are subject to variations of temperature were carefully wrapped with asbestos paper and then insulated before the wall was plastered with cement mortar. The first and the second floor finish in the principal rooms is 1¼″ oak nailed to strips embedded in the concrete. The kitchen and the servants' room, basement and third floor slabs are given a granolithic finish, as are also the basement stairs and the stairs from the second to the third floor. The enclosed porches are floored with Adamantile[4] and the open porch at the front is floored with red concrete tile 9″ x 9″, set with black mortar joints. It will be noted that this porch is really the roof of the 16′ x 32′ concrete cistern. The water from the cistern is pumped by a lift actuated by city water pressure to a reinforced concrete tank in the attic. The attic floor slab forms the bottom of the tank. The ceiling of the library is furred and all ceilings are plastered with Keene's cement, but the walls are plastered with portland cement mortar.

The exterior finish is stucco direct on the concrete wall, the rough concrete surface forming an excellent key. The body of the stucco is rough-cast, but smooth borders are left around the windows at the sides of the building, which give a very attractive finish. At either side of the main doorway and at the corner of the second floor sleeping porches ornamental cast stone were used, as can be best seen by an inspection of a detail of the main entrance, shown elsewhere in this issue. This ornamental work was cast on the job in plaster molds. The molds were set in place and the rough concrete placed around them, together with the proper reinforcing. The fireplace on the north porch is of Caen stone and extends from floor to ceiling. The fireplace in the library has a Caen stone facing with a wood mantel.

INTERIOR TRIM

The trim of the first story is oak; the second story has white enamel and mahogany finish. The wall dec-

[1]From CONCRETE, Jan., 1916.

[2]Vice-Pres. and Gen. Mgr., Dewey Portland Cement Co., Kansas City, Mo.

orations are entirely of white lead and oil applied directly to the plaster. The windows are nearly all casements, opening out.

Construction

Work was started October, 1914, and the building was completed ready for occupancy the first week in July, 1915.

Reinforced concrete footings 12″ deep were placed under all walls. On this footing, work was started with hollow wall machines, building a 4″ outside and a 6″ inside wall with a $2\frac{1}{2}$″ continuous air space. As will be seen by the illustrations, the front of the house has a very heavy water table extending well below grade. This projection was built with the hollow wall machine by running the inside wall first and then going over the wall a second time with a wall machine having the core removed and building a 12″ wall at the proper height. The machine was set back 4″ to form the double water table effect and later another 4″ to bring it to the final wall thickness. Flower boxes were cast on this base under the windows in the two front porches.

Floors—Basement walls were brought to the level of the bottom of the first floor slab, the outer wall being continued to the top of the slab, the inner wall being lower by the thickness of the slab. Forms were then placed and the first floor poured. It will be noted that the main partition in the basement and at the end of the living room in the upper stories are also of double wall construction and support the floors. Other partitions are of metal lath on metal studs, plastered with portland cement mortar. Above the level of the first floor the wall was reduced to two 4″ walls and contained at that thickness for the two remaining stories. The second and the third floor slab were poured as the wall reached their levels. The second floor slab is supported on the inside wall and the third floor slab is cantilevered to form the cornice as shown in the section at Fig. 1, with the gutter molded directly in the slab. It will be seen that a suitable abutment for the rafters is also formed on this slab. The frame for the roof is of wood, being practically the only woodwork in the building aside from the trim. The roof is covered with red concrete tile, which form not only an attractive but an economical and exceedingly durable fireproof roof.

The long beams which support the floor of the living room and also span the corresponding space on the second and third floors, are of reinforced concrete 12″ x 14″ in section. A detail of this beam is shown in Fig. 2, just above the basement plan. The first and the second floor slab on these beams are 6″ thick, reinforced with No. 8 Ribbed metal. Other structural

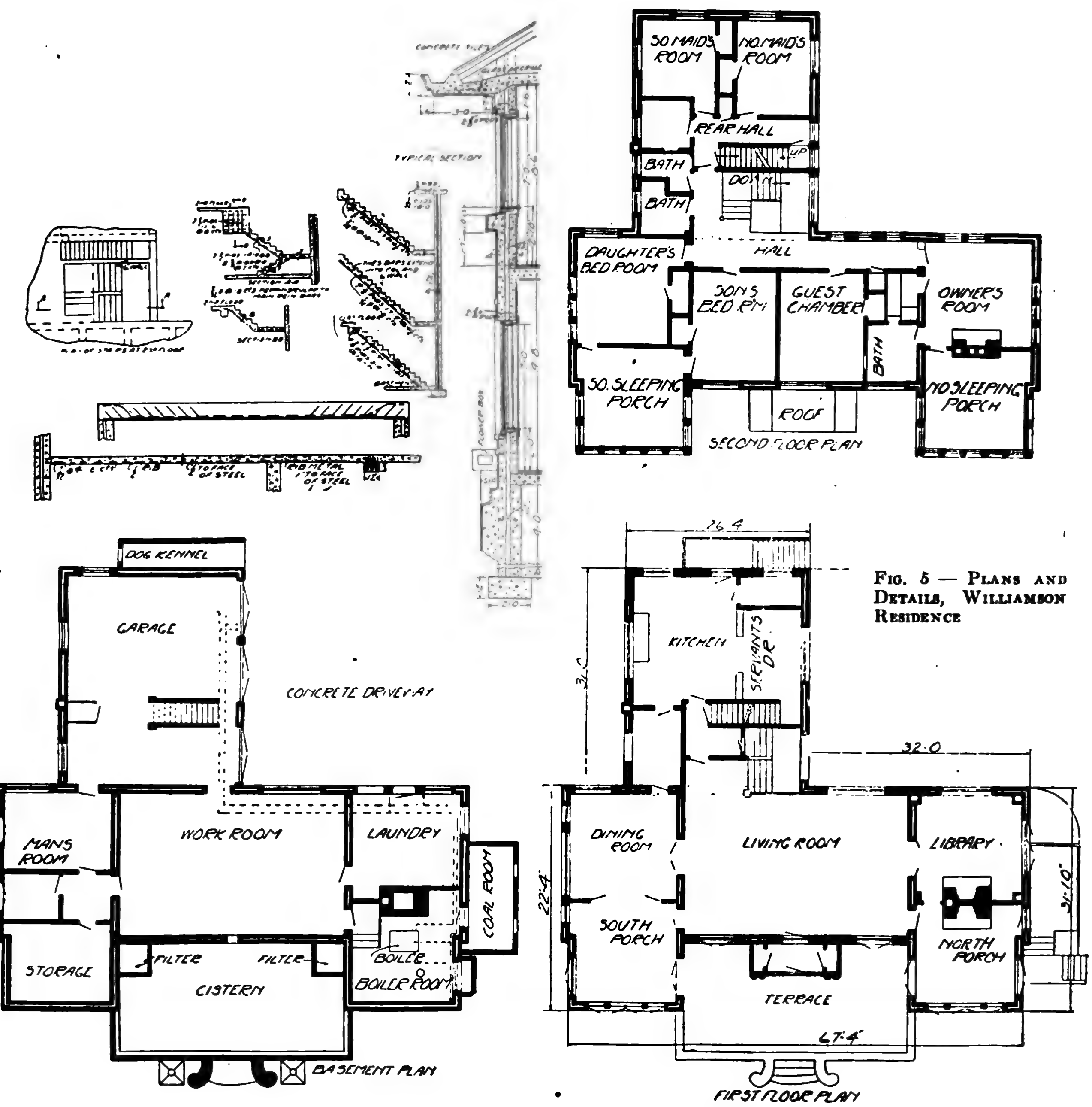


Fig. 5 — Plans and Details, Williamson Residence

floors are of flat slab construction reinforced with ribbed metal and vary in thickness from 4" to 6½", according to area.

The concrete was of cement, sand and 1¼" crushed stone. It was mixed in a Jaeger mixer, with 4½ h. p. engine located in the basement. A wooden charging hopper was filled through one of the basement windows. From the mixer the concrete was handled in wheelbarrows which were elevated on a lift operated by a hoist on the mixer. The lift was located in the stair well of the rear hall, the stairs being omitted until all other concrete was placed and were then built from the top down. Details of the stair construction are shown in Fig. 5.

Cost Data

As competitive bids were not taken, exact comparative data are not available. It is the owner's belief, however, that the building cost less than it would have, had the wall construction been of stone or of brick. Unit wall costs are given as follows by George E. Lewis: Crushed stone, $1.50 per cu. yd.; sand, $2.00 per cu. yd.; cement, $1.25 per bbl. The machine operators were inexperienced and were broken in on this job. All concrete walls taken together, including the heavy basement walls, cost 19 cts. per sq. ft., including supervision. The 4" double wall figured separately cost 15½ cts. per sq. ft. This is exclusive of the stucco finish.

Fig. 1—Residence of L. Williams at Waco, Texas

Concrete, Boulders and Casements, Features of Waco House[1]

The attractive residence of L. Williams at Waco, Tex., which was designed by Edward H. Reed, architect, Waco, and built by Harris & Hewitt, contractors, Waco, is far from looking severe or cold.

Construction

Its walls were built with a double wall machine.

The exterior of the house is finished in portland cement stucco, and the interior is plastered direct to the concrete wall, without fear of dampness, owing to the double construction.

The builders have itemized the cost of the house, exclusive of the slate roof and oak floors, which were furnished under separate contracts. These costs are based on the following wage scale: Plasterers, 87½ cts. per hour; painters, 50 cts. per hour; laborers, 25 cts. per hour; carpenters, 50 cts. per hour.

Details of Cost	
Excavating	$ 258.40
Concrete walls and footings	1,088.80
Brick and cobblestone	500.00
Plaster, stucco and concrete floors	1,402.00
Tile for bathroom	54.00
Iron	88.00
Wiring	167.00
Tin and heating	489.00
Hardware	200.00
Labor on carpenter work	1,465.00
Mill work and labor	1,390.00
Lumber	1,285.00
Painting	700.00
Plumbing	600.00
	$9,588.20

[1]From Concrete, Jan., 1916.

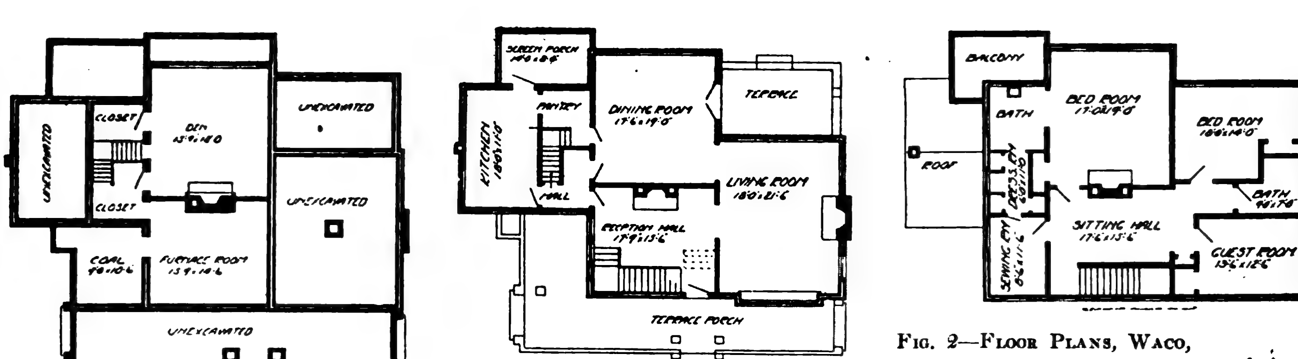


Fig. 2—Floor Plans, Waco, Texas House

A Concrete House at Glen Ridge

By Edward F. Washburn
Architect

The very attractive Glen Ridge, N. J., residence of Wilson D. Lyon—an example of Americanized Italian architecture—was designed and its construction superintended by Edward F. Washburn, architect, New York City. It stands at Ridgewood and Linden avenues, set 200 ft. back from the former, which is the town's chief residence thoroughfare. (See page ????).

The concrete construction by the double-wall Van Guilder system, was by the Schouler Cement Construction Co. The house was built of cinder concrete, 1 part portland cement, 2 parts of clean, sharp sand, and 4 parts of clean, steam washed, hard coal cinders, machine mixed. The exterior walls are double throughout, with a 2½″ air space from the top of the footings in the cellar to the plate at the roof. There is no connection between these two walls, with the exception of ¼″ tie wires, which are placed 2′ apart horizontally across the air space, on every course, the courses being 9″ high.

Stucco was applied directly on the wall, outside, and the plaster directly on the inside surface.

The foundation walls are 6″ thick up to the top of the first floor beams, where the outside shell changes to a 4″ wall, the 2″ forming a water table, and the inside shell continues up at 6″ thick to the under side of the second floor beams, resting on the offset, so that the wall from the second floor to the plate at the roof is formed of two 4″ walls with a 2½″ air space.

The house has a red Ludowici Spanish tile roof, with a fire flashed finish, giving a mottled effect, colors ranging from a terra cotta red to a blue-gray tone.

There is a 3′ overhang at the roof, solid cypress gutter, sawed rafter ends, and the exposed soffit under the overhang sealed with 6″ cypress boards running parallel with the gutter, and the joints covered in between the rafters with 2″ x ½″ battered strips of Italian detail.

The exterior stucco is a little off the white, a buff tinge, with a fine spatterdash finish, and the base, up to the water table, is finished smooth. Window sills, copings, exterior steps and architrave around entrance door are of the same finish. The railings and flower baskets are of iron painted black, secured into the concrete with lead. The small tile inserts in the 2″ recessed arches over the first floor windows are formed with 4″ x 4″ faience dark green tile. On the pedestals of the front terrace wall are Italian urns of concrete of a terra cotta color, to carry the color of the roof, with the copper leaders also painted terra cotta. Trimmings and sash are of a neutral gray. The little spots of color in the tiles and the fine iron detail spots which are black, give the exterior a very interesting appearance.

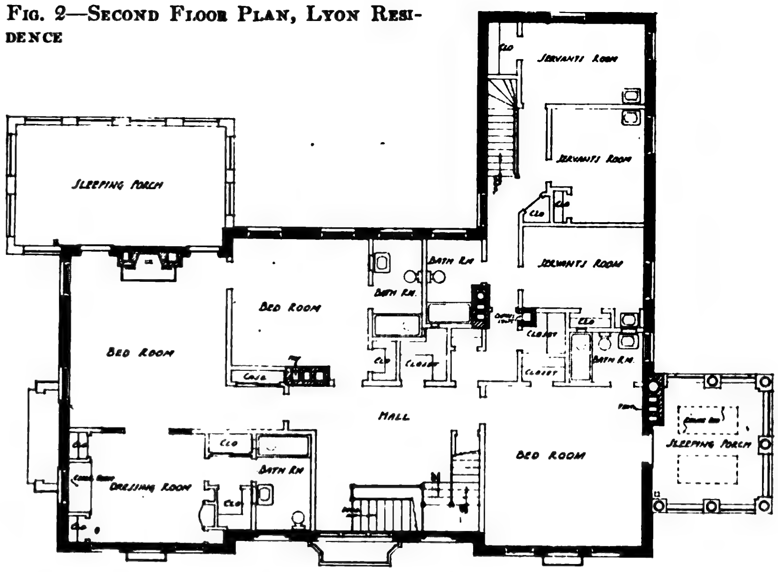


FIG. 2—SECOND FLOOR PLAN, LYON RESIDENCE

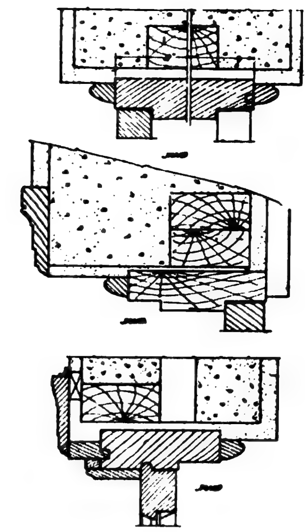


FIG. 4—JAMB DETAILS

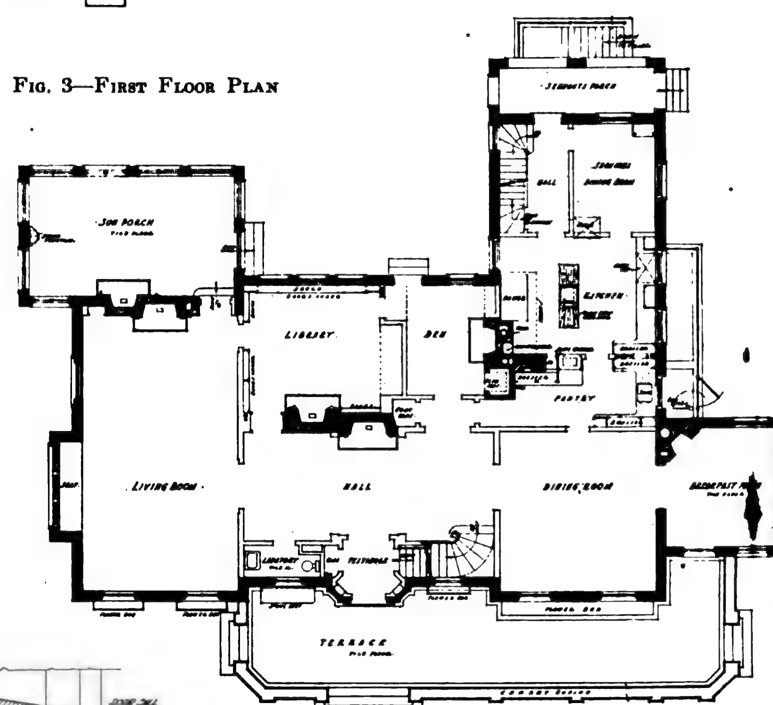
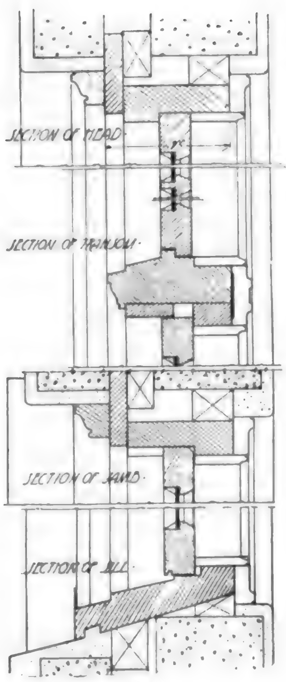
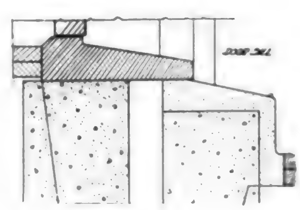
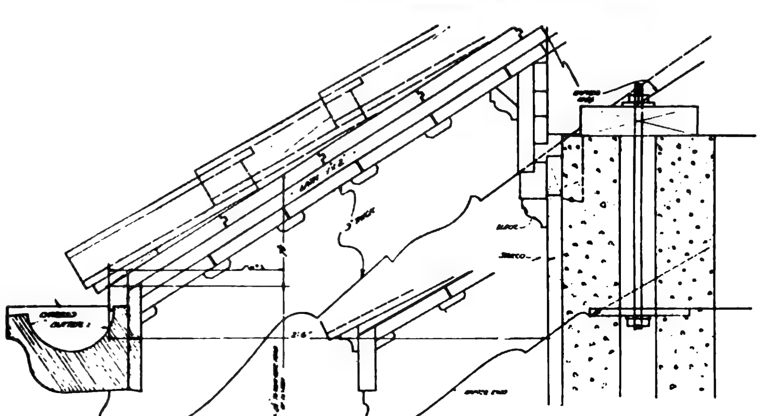
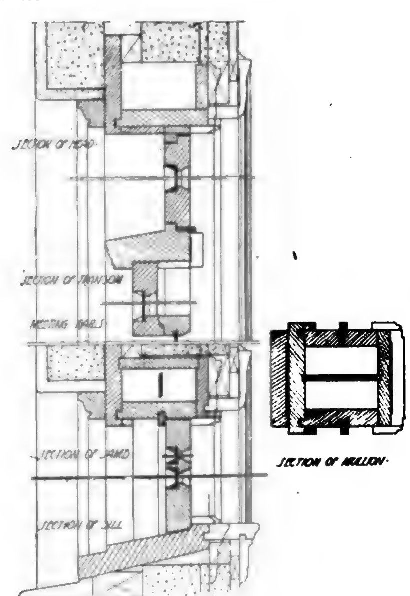


FIG. 3—FIRST FLOOR PLAN









FIGS. 5-8—WINDOW, DOORSILL, RAFTER END, AND MORE WINDOW DETAILS

75 Dwellings of Monolithic Concrete at Claymont, Del.[1]

Fig. 1—Practically Finished Group of Concrete Walled Dwellings for General Chemical Co., Claymont, Del.

Seventy-five dwellings, walled with monolithic concrete are included in a 187-house group for the General Chemical Co. at its Marcus Hook plant, Claymont, Del.

The site is on the high land overlooking the Delaware River, 7 miles from Wilmington, giving the community its name—Overlook Colony. The project is being carried out under the direction of Robert Painter and Dr. C. F. Ford, of the service department of the chemical company, and T. V. Fowler and W. H. Anderson of the engineering department.

John Nolan, landscape architect, Cambridge, Mass., laid out the property. The houses were designed by H. Enol Coffin, architect, New York City.

Part of the property has been laid out for detached dwellings. For the less expensive houses the grouping plan was adopted, building several houses in a block. The 75 concrete houses have been put up in solid rows.

Types of Construction

The different types of wall construction used at Overlook Colony are as follows: (1) reinforced concrete with stucco finish; (2) T. C. tile with stucco finish; (3) metal lath on metal lumber with stucco finish; (4) brick veneer over wood frame and sheathing; (5) stucco on metal lath over wood frame and wood sheathing. The party walls between dwellings are of terra cotta or concrete. The exterior walls of all are of fireproof or at least fire-resisting construction.

Part of the concrete walls was put up by the use of wood forms and part of the work was done with steel forms.

Data compiled on the various types of construction showed that concrete walls cast in steel forms cost considerably less than for the tile walls. The concrete walls made in wood forms cost slightly more than tile walls.

The floors in the bath and toilet rooms are of concrete with a cement finish. The floors of the living room and kitchen are of wood, laid over cypress sleepers, which are bedded in a cinder concrete slab. All of the houses have the second floor construction of the usual wood type on wood joists.

The House Plans

The reader will note that the houses are all planned to be but two rooms deep; they are simple and straightforward; the houses as well as the rooms are nearly square.

One chimney serves for two dwellings. One plumbing stack also serves for two dwellings. There is a minimum of hall space. Fig. 3 shows the plans of the four-room type of house—the first floor has the living room in the front and a combination dining room and kitchen in the rear. Fig. 4 shows the plan of the concrete houses, of which type there are 75.

The living room is at the front—the kitchen is at the rear—the bathroom adjoins the kitchen. The houses as built have the range located next to the bathroom, so that all piping is reduced to a minimum. In order to save space, a short built-in enameled iron bathtub is used. This tub is only 3′ to 4′ long, and is built in the space between the bathroom walls; the plaster finishes down on the rim of the tub. The second story has three bedrooms, making these five-room houses.

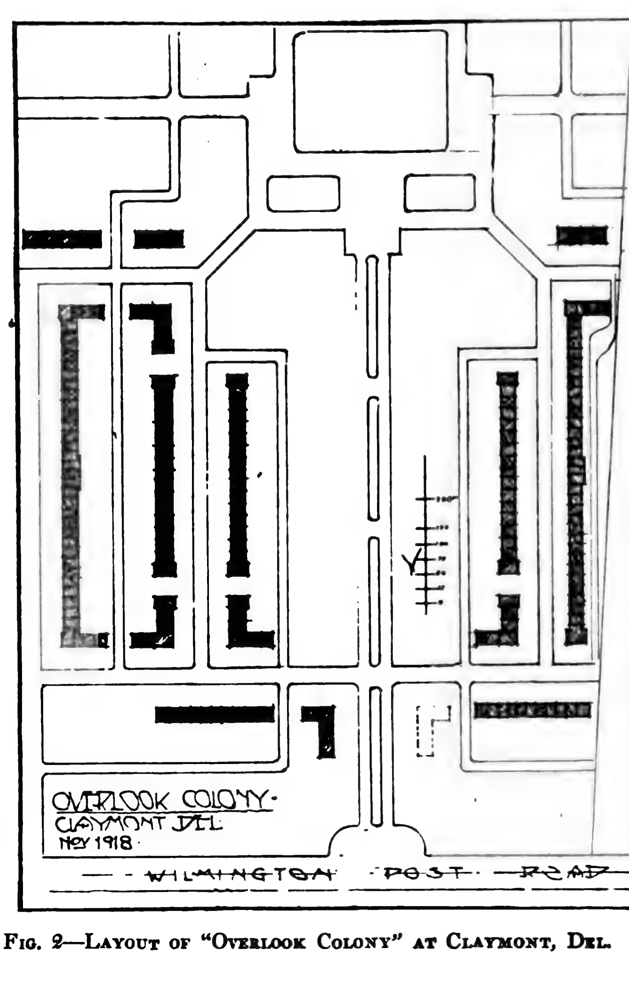
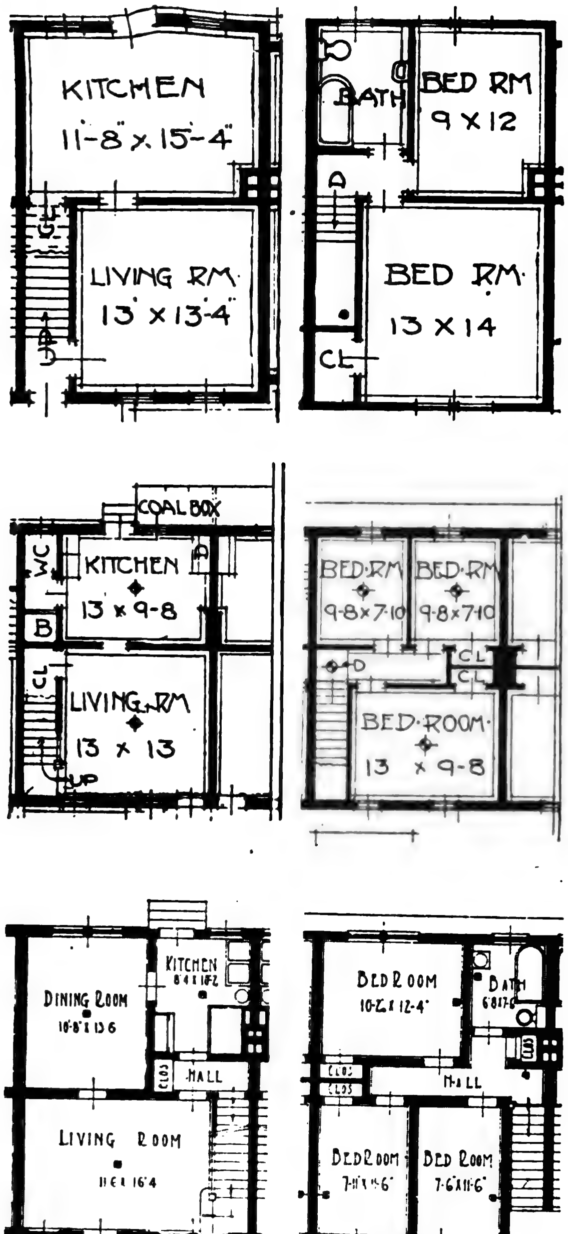


Fig. 2—Layout of "Overlook Colony" at Claymont, Del.

[1]From Concrete, Jan., 1919.



Figs. 3, 4, and 5—Plans Top to Bottom of Four, Five and Six-Room Houses at Claymont

The largest of the houses in the Colony group are of the six-room type, shown in Fig. 5. In the first story there are living room, dining room and kitchen. In the second story are three bedrooms and bathroom, which makes a six-room house.

The concrete houses are built to fill the need for housing the families of the unskilled workmen. The rent for a four-room house is $20.00; for a five-room house $25.00, and for a six-room house, $30.00. In order to make the rent as low as possible, the four and five-room houses have been built without cellars, to be heated by stoves. Concrete boxes for keeping fuel are located just outside the kitchen doors. For the heating of the bedrooms, double registers are located in the ceiling of the first story, which connect with rooms above.

Stucco Finish

After pointing up the walls the finish was applied in a single coat of stucco, mixed one part Atlas White cement to two parts white sand. The average thickness of this coat is ¼″. It was applied with a trowel in the usual way, and was followed by going over with a trowel, dragging the edge so as to leave the surface with a texture somewhat like tapestry or wirecut brick. The result is a somewhat rough finish, which affords considerable variety. This single coat of rough stucco makes

Fig. 6—Light, Handy Scaffold Brackets Merely Leaned Against Wall and Staked at Bottom; Staging Plank Nailed to Prevent Side Movement

Figs. 7 and 8—Show How Frames Are Set in, with Steel Forms Extending Over

perhaps the least expensive, permanent finish which can be given to a concrete wall. The rough texture does away with the difficulty from crazing, which is almost sure to show in a smooth trowel finish of rich mix. The rough finish also covers any slight twist in the wall surface.

Variety in Slate Roofs

The roofs are all covered with random width sea green slate of variegated shades. This gives considerable life and color to the roofs and takes away the dull uniformity of a row of black slate roofs.

Construction

Trench Foundations—The concrete houses are built without cellars. For the foundation trenches, 3′ 6″, 16″ wide were cut in the clay (see Fig. 9). As soon as the trenches were completed screed boards were set 8′ apart across the trench. The trenches were then filled with concrete, the top was worked off level with a straight-edge resting on the screed boards. The foundation was then complete, ready to receive the first course of the steel forms for the first story walls.

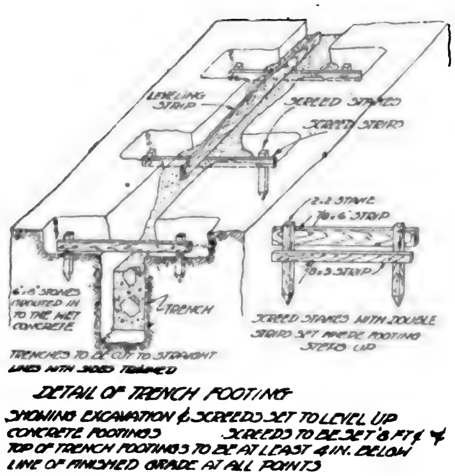


FIG. 9

Grouting Stones—In a portion of the foundation stones weighing from 10 to 20 lbs. were grouted into the concrete as the trenches were filled. The mixer was set up beside the trenches, so that the concrete was spouted direct. The mixer was moved along as the work progressed.

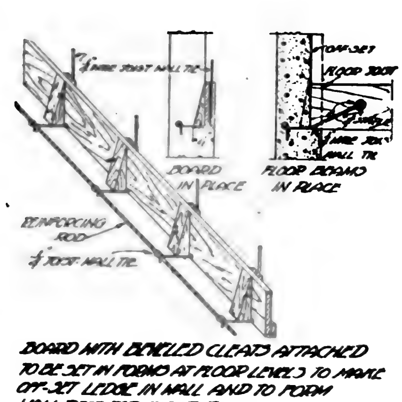


FIG. 10

Bearing for Floor Beams

The first story walls are 8″ thick, dropping back to 6″ at the second story. In order to get a 4″ bearing for the floor joists, and to form the offset to the 6″ wall, beveled blocks, 2″ x 8″ were tacked to form board (see Fig. 10); the form board, with the beveled blocks attached, was set in the steel form at the required level. Quarter inch wire anchors were bedded in the wall and left with ends projecting. When the wood floor joist were put in place these wire anchors were spiked to the ends of the wood joist.

Fig. 11 shows a vertical section through the party walls and chimneys. The flues are started just below the second floor beams. The flue from the kitchen range

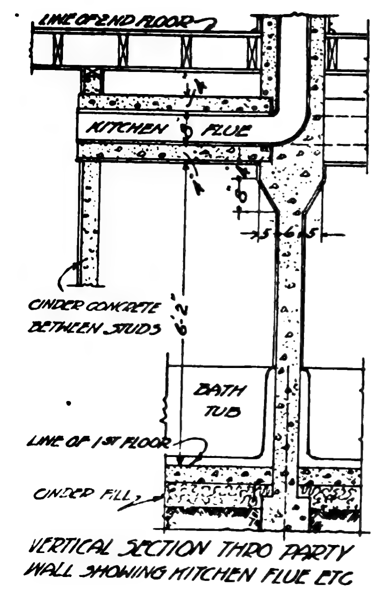


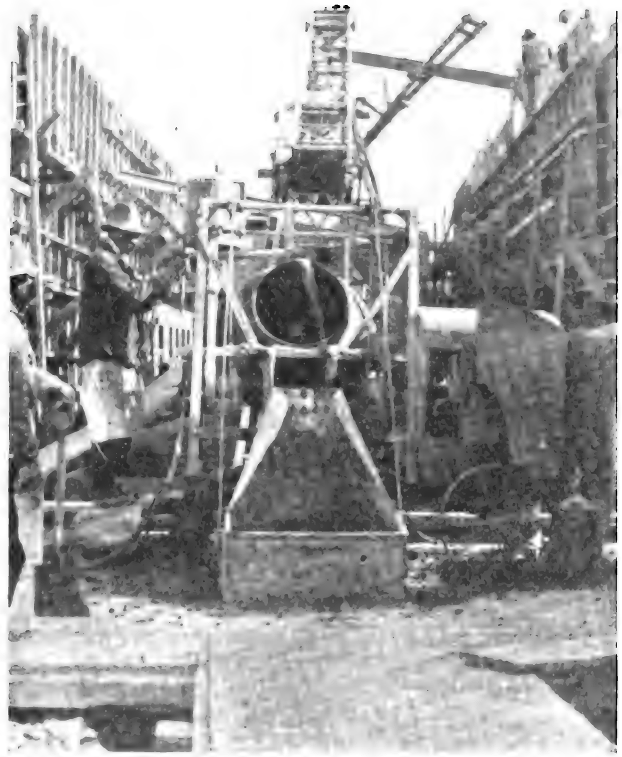
FIG. 11

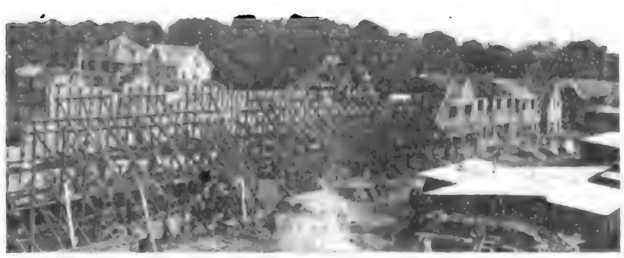
is carried across the bathroom in the shape of a hollow reinforced concrete beam. All flues have terra cotta linings.

Cinder Aggregate—Concrete for walls has crushed cinder aggregate; the loads are extremely light in this case, the maximum being 102 lbs. per sq. in.; whereas samples of the cinder concrete were tested to stand 1,300 lbs. per sq. in. when 90 days old. Here, as in many manufacturing sections, cinders are a waste product and the only cost is that of hauling, whereas gravel and crushed stone cost $2.50 per ton on the job. The cinder concrete has a slightly porous surface, which gives a good bond for the one coat of white cement stucco finish. All interior furring and finish has been nailed direct to the cinder concrete wall, thus eliminating the need for wood nailing blocks in the concrete or of plugging the walls. The mix used for part of the work was 1 part Atlas cement, 1½ parts sand, 3 parts cinders. This was changed to 1:3:4, which proved amply rich for these light house walls.

The Wood Form Work—On that part of the work on which standard steel forms were not used, panels were made of ⅞″ square edge N. C. pine sheathing, nailed to 2 x 4's, 24″ o. c. These panels were set up two sections at one time and wired together. The concrete was poured in any section, 5′ in length, and allowed to set before the top section of forms was filled. They were then removed and reset and the second story walls poured. The concrete was mixed and spouted by a Jaeger outfit, as shown in Fig. 12. The mixer and spouting outfit was set on a high platform, so that by the use of rollers the whole outfit could be moved along as the work progressed.

The Steel Form Work—In the work done with the steel form outfit quite a different procedure was followed.



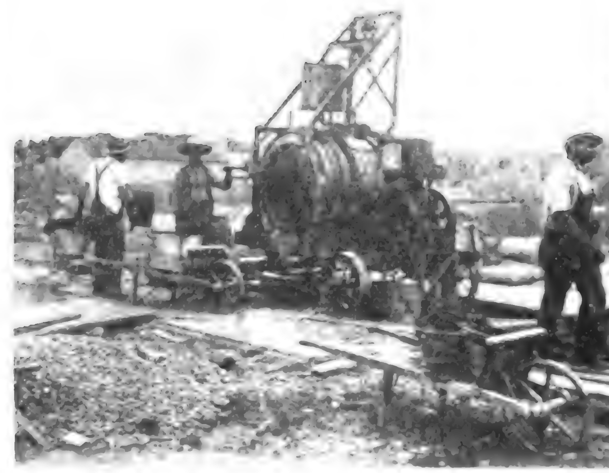


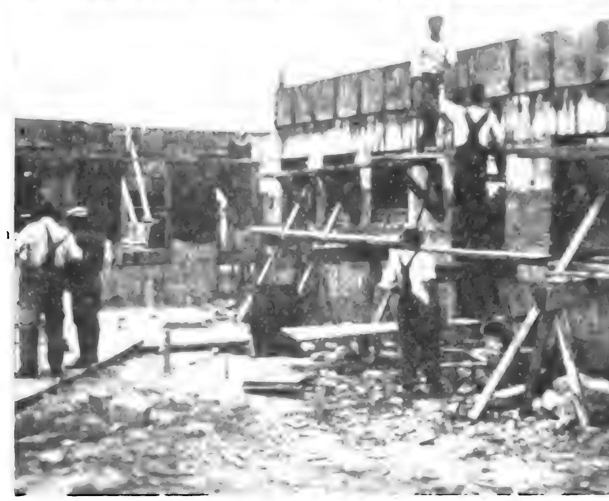
Figs. 12 and 13—Construction in Progress on Part of Work Using Wood Forms and Mixer, with Spouting Outfit

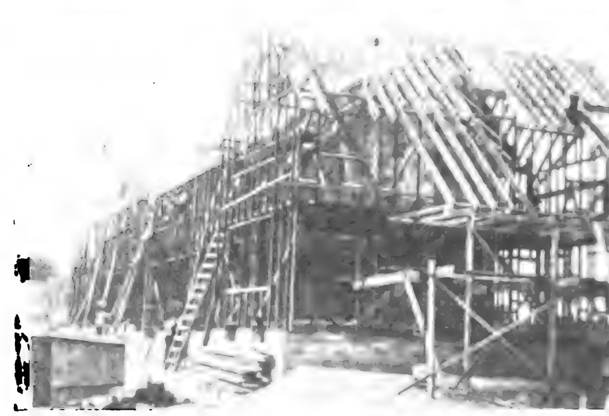
The walls were made by a continuous process of molding concrete blocks in place on the wall. One tier of steel forms only was employed. In from two to three hours after each course of the forms or molds was filled the concrete had set up sufficiently so that the forms could be removed and reset. Each pair of forms or one mold, as it might be called, made a block 22" high by 24" long. The forms were set across all doors and windows. The frames were built out to the full thickness of the wall and those frames were dropped in between the forms and the concrete was poured around so that all frames were built in as the walls went up.

The concrete was mixed to a mushy but not a sloppy consistency. The forms were filled with wheelbarrows from an inside movable scaffold. The posts of this scaffold were 4 x 4's, with holes bored 12" o. c. Ledger beams were supported by pins through the posts at any desired level. This moving scaffold was designed to be carried to such a height above the level of the forms that the concrete could be dumped into the forms from the barrows. The pouring was carried on so that wall stepped up one course every 16 feet, so that the walls of ten houses were under construction at one time. At one end the walls were just starting and at the other end they were plate high. In this way the job was laid out so that the work could be continuous in operation. While one crew was putting in foundations, another crew up the line was setting second floor joists and a third crew was putting on the roof, while a fourth was installing partitions. One crew would be plastering, another trimming, and still another crew would be hanging doors and sash. And so on to painting, cleaning and locking the door of the finished house. It was intended to standardize the work of each crew, and allow it to continue doing that same work on house after house, so as to make a substantial saving in the labor cost as well as speed up the job. As the work was originally laid out, it was estimated that after the work was well started the houses should finish out at the rate of one house every two days.

By this method of building concrete walls, the mixing and placing is made a continuous process. The size of







Figs. 14 and 15—(T and Center) Mixer Plant and Steel Form Work on Concrete Houses

Fig. 16—Metal Lumber Under Construction

the outfit of steel forms or molds, as they are called, depends only on the size of the crew and the speed of construction desired. As shown in Fig. 15, the process includes the removal of plates on the finished wall and resetting and refilling the plates in front. If a stiff mix is used, and tamped in place, somewhat like that used in the usual concrete block, the forms can be removed at once, but with "quaking mix," which produces a stronger concrete, it is found to be necessary to leave the forms on the wall from two to three hours, according to weather conditions and to protect the newly cast wall from rain.

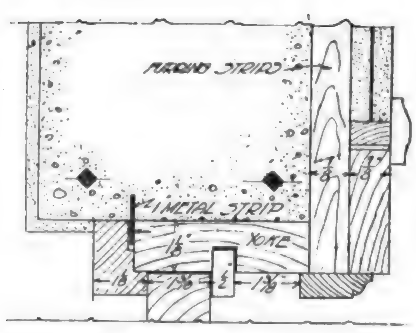
Fig. 6 shows the light scaffolds which were used on the short runs of wall and wherever the heavy scaffold and wheelbarrows could not be used to advantage. Coal hods were used to place the concrete in the forms, four of these carried in a barrow. The concrete cannot be placed at as low a cost as where wheelbarrows or spouts can be used, but the cost of building a tower and moving the chutes for this wall work made it more expensive than the hand placed material, owing to the small yardage involved.

Window Frames and Other Details

All frames were built up on the job. In Fig. 17 is shown a vertical section through the window head. A strip of tin is tacked to the yoke and extends up into the concrete. This makes a joint that is airtight as well as watertight.

A plan cut through the side of the window frame is also shown. The sash weight box is formed by tacking a channel shaped metal strip to the pulley stile. The sill and the yoke are cut long, so that this metal weight box has a secure nailing top and bottom. On account of the channel shape of this metal weight box, it makes a very rigid frame and is at the same time lighter and less expensive than the usual wood frame. (See Fig. 18.)

The frames were made up with a reveal strip tacked on in place of the staff, as shown in the detail. These temporary reveal strips built the frames out to the thickness of the walls, so that the frames complete were set in the steel forms at any point desired, and the concrete poured around these frames, making a weather tight joint. By the use of this simple metal weight box



SECTION THRO. WINDOW HEAD IN 6" WALL
WINDOWS IN 8" WALL SIMILAR

Fig. 17

the wood work, which is sure to shrink, is reduced to a minimum when the concrete is poured around the windows. The temporary reveal strips are removed and the staff strip is applied. This serves both as a finish and forms the sash runway. The stucco was finished up against the staff. The reveal strips were made of 1/4" cypress, so that they were used over and over again.

A sill detail is shown, with a drip under the sash. The temporary reveal strips extend down below the wood sill and form a recess. The finished concrete sill is afterwards molded in place. Wires are left projecting in the sill recess, which furnish a secure bond (Fig. 19).

The outside wood sill is applied after the concrete sill is finished and is so arranged as to extend down and cover the joint between the main wood sill and the concrete. This outside wood sill is set with a white lead

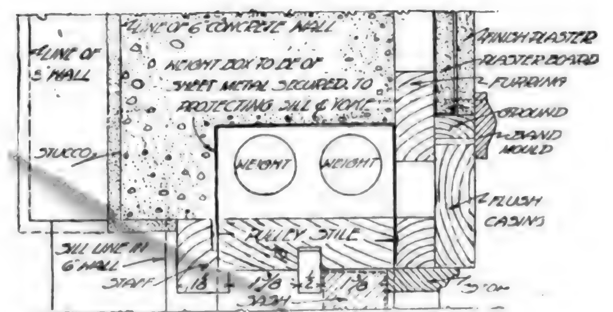


Fig. 18

joint. While time is the best test of new structural details, such, for instance, as this window sill, it seems quite possible that it will eliminate one of the difficulties in concrete house building—the making of watertight window sills. The brick in the usual wall are so porous that they absorb any water that beats in under the sill, but the concrete does not take the water so freely and this accounts perhaps for the fact that windows in some

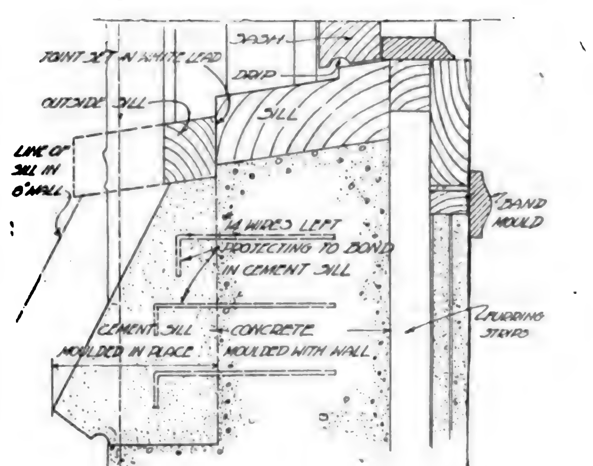


Fig. 19

of our concrete houses have given trouble from leaks. As a rule the frames are much more nearly weatherproof in a concrete wall than in a brick wall.

Flush Trim—All of the interior finish in these concrete houses is set flush with the plaster, instead of projecting as is the usual custom. This reduces the woodwork to a minimum and the flush finish largely eliminates the dust catchers. The woodwork receives the first coat of stain before it is put in place. It was the original intention to eliminate all grounds, as plaster board was used, applying the sand finish flush with the casing. The trim would without doubt be smeared over with plaster to some extent, but it was proposed to follow the plasterers up, cleaning off the trim, then to apply a second coat of dark stain, which would cover up any stained parts, and finally to apply the band mold, much as a picture mold is put up in finished condition. The wood base is also put up flush with the plaster, and the band mold extends along the top of the base and mitres up and around the doorways. The usual projecting stool at the windows has been omitted.

All exterior walls were furred with 1 x 2's, 16" o. c. Furring strips were secured by nailing direct into the cinder concrete walls.

Fig. 1—W. F. Payson's Concrete House, Near Darien, Conn.—Howard Greenley, Architect—From a Color Drawing of the Architect's Conception of the Finished Work

Concrete Walled Houses on Long Island Sound[1]

By Milton Dana Morrill

Just west of the Long Island Sound shore development of Tokeneke and in the township of Darien, Conn., a most interesting group of concrete houses is under way. On the first two just now the finishing touches only are lacking. They were designed by New York architects, who have come to know what great possibilities concrete offers in the building of more permanent and attractive country residences.

The first of these houses, for F. Raymond Holland, the painter, stands on the rocks close to the water's edge. It is a rambling pile, having been planned in the style of a fisherman's cottage on an Italian shore. The architect is F. H. Bosworth, Jr. [The Holland house completed is illustrated elsewhere in this book.—Editor.]

The walls are of a 1:3:5 concrete, mixed wet, with 5% hydraded lime added for density, and to make the concrete flow more freely in the spouts. The first story walls are 9″ thick, and in the second they are 7″; ⅜″ reinforcing rods are spaced 2′ o. c. both vertically and horizontally. A small portion of the floor is of concrete slab construction, but most of the interior work is of the usual wooden beams and stud partitions. The roofs are covered with green mat glazed tile. The exterior walls are being finished with a one-coat stucco made of 1 part portland cement to 1 part sand, with 5% hydraded lime added. The arched loggia is an interesting feature. To take advantage of a natural vista toward the sea, the builder was called upon to make an archway directly in the corner. An illustration shows the ingenious way in which this was accomplished.

The second house is for W. F. Payson, New York City, president of the Atlas Advertising Co. Howard Greenley, who is the architect for this house, has adapted his plan and design distinctly for concrete, and in its character has studied the material carefully. Some of his details are of especial interest.

The construction of the walls was similar to that of Mr. Holland's house. They were poured in steel forms by the Morrill system, involving the use of steel pan-like forms 2′ sq., clamped on the flanges and usually raised in an entire 2′ tier at one operation.

The walls were put up and the building completed to the roof in 14 working days, advancing on an average of 2′ each day, placing the concrete with a Jaeger spouting outfit.

A force of 12 men raised and set the forms and poured a 2′ course of concrete each day around the building, a total of 216′. The average labor cost of removing, cleaning and setting up steel forms and placing window frames was 2c per sq. ft. surface measure. The labor cost of mixing and pouring the concrete in the forms was $1.60 per cu. yd., or about 4½c per sq. ft. of wall. To this must be added something for the use of the mixing and hoisting outfit, as well as for the use of the steel forms, but as these can be used over and over again, it makes a small item per sq. ft. of wall. This has been estimated at ½c, which covers the interest on the investment and the wear and tear expense.

The walls are 8″ thick, reinforced by ⅜″ rods spaced 24″ o. c. horizontally and vertically, like the Holland

[1] From Concrete, January, 1918.

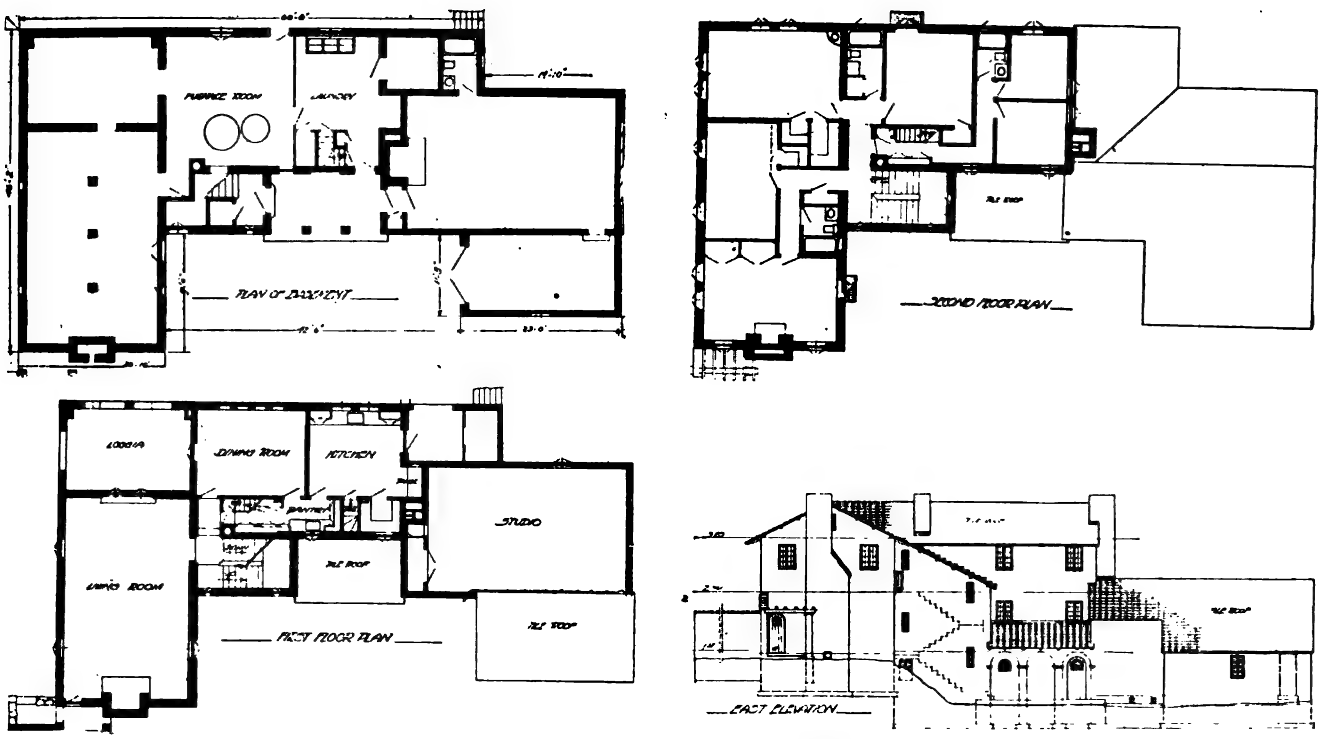


Fig. 2—Floor Plans and East Elevation, Mr. Holland's House, Which Was Originally Designed for Hollow Tile and Subsequently Changed for Concrete

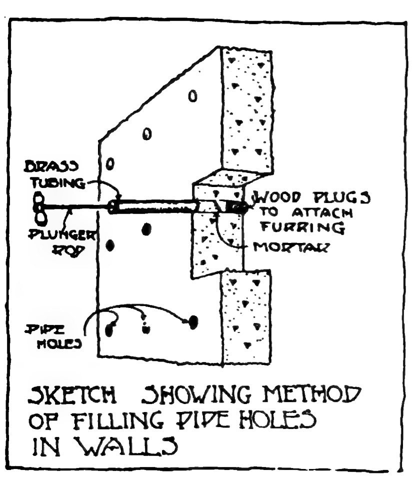


Fig. 4—Filling Holes in Wall Left by Form Spacers

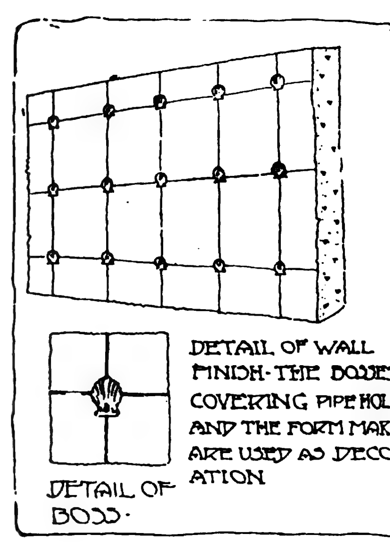


Fig. 5—An Idea for the Decorative Treatment of a Morrill System Wall, Suggested by the Architect, Howard Greenley—The Shell Bosses Being Particularly Appropriate for a Seashore Dwelling

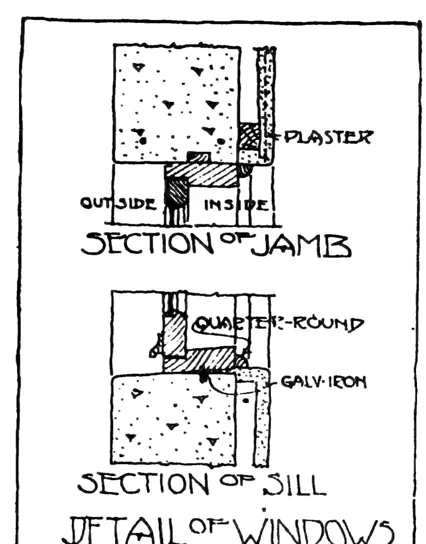


Fig. 6—Window Details, Payson House

house. Pipe separators were used between the steel forms. As these were driven out, 1¼″ holes were left through the walls, and these were employed to secure light steel scaffold brackets, which were raised as the work went up. Into these holes, which were spaced just 24″ o. c., wooden plugs were driven, to which furring strips on the inside of the wall were spiked. The holes were then filled from the outside by an ingenious plan, which is shown in Fig. 4. A piece of pipe about 15″ long was fitted with a plunger, rod and handle. This "gun" was filled with a cement and lime mortar by dipping the pipe well down into the pail of mortar and drawing up the handle. The end of the pipe was then inserted in the hole and the plunger used to force in the mortar.

As a slight pattern is left by the steel forms on the walls, and the pipe holes come just where these squares join, the architect, Mr. Greenley, proposed to adopt this pattern as the basis of a decorative scheme by covering the holes with small pre-cast ornamental bosses. Fig. 5 shows how, in this way, a decorative effect may be obtained. The owner in this case preferred a stucco covering.

Fig. 7 shows the method employed to put in the second story floor joist, as there was no offset in the wall at this level; 2 x 4 pieces were bedded in the wall as the concrete was placed. To these nailing blocks a strip or ribbon was spiked at the proper level to catch the bottom of the floor joist, and the furring strips are nailed up under to give support to the ribbon. Wall anchors

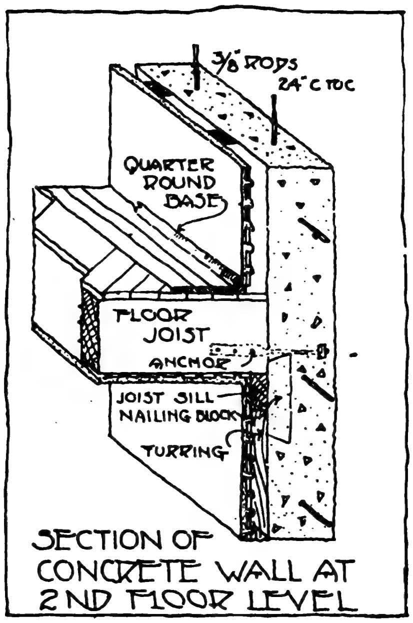
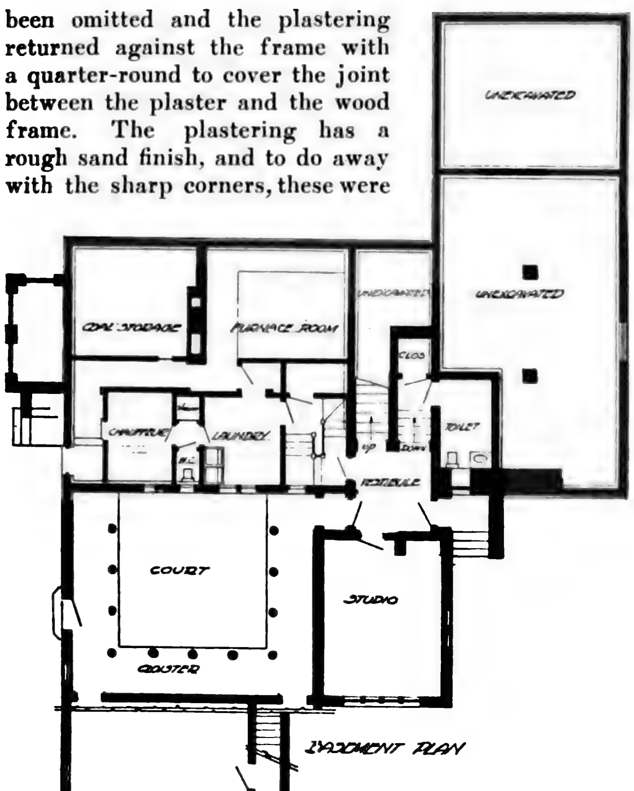


FIG. 7—WALL AND FLOOR SECTION AT SECOND STORY LEVEL

may be put in as often as desired and spiked to the side of the joist.

This illustration also shows the simple way in which the interior is trimmed. The ordinary wood baseboard was left out and a quarter-round nailed to cover the joint between the floor and the wall.

Fig. 6 shows a section through the window frame in which the usual wood trim has been omitted and the plastering returned against the frame with a quarter-round to cover the joint between the plaster and the wood frame. The plastering has a rough sand finish, and to do away with the sharp corners, these were



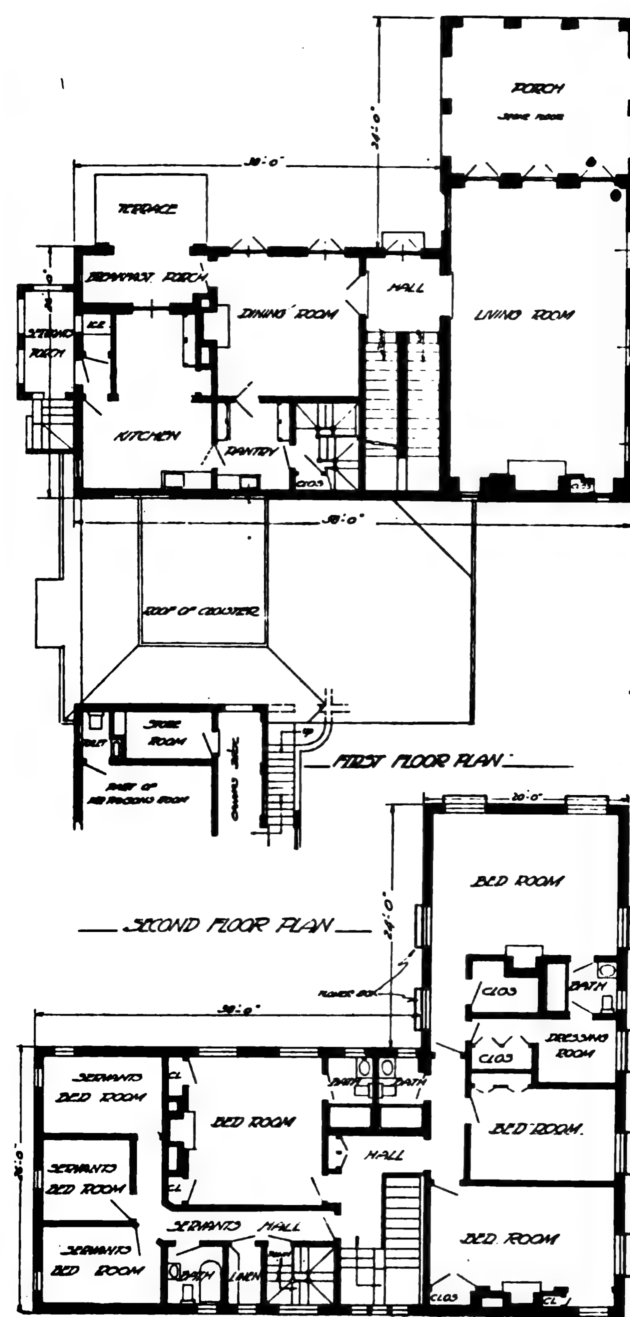


FIG. 3—FLOOR PLANS, MR. PAYSON'S HOUSE—HOWARD GREENLEY, ARCHITECT

The two-foot squares indicate the adaptation of the Morrill wall form units.

rubbed down with the hand as soon as the plaster was applied.

These houses were built by W. G. Wood, South Norwalk, Conn.

The stucco finish on the walls was put on in a single coat about 1/4" thick, applied with a plasterer's trowel. The walls were not wet down, but all dry dust was removed. The wall surface was left smooth by the steel forms, and it was at first questioned if there was not danger that this thin coat of stucco would eventually peel off. Experience, however, seems to prove the contrary, and on a considerable number of buildings finished in this way six years ago there is no sign of the separation of the stucco. It appears to be a permanent as well as a rather inexpensive way to finish these steel molded concrete walls. After this stucco was troweled on and had been allowed to stand a few minutes, the surface was gone over lightly with a cork float. A little water was thrown on with a brush, as needed, while the surface was being floated.

In order to get at the exact cost of this wall finish, the time and material used on finishing a surface of 142 sq. yds. was kept, no allowance being made for openings.

Labor and Material, 142 sq. yds. of Stucco—		
½ day, 3 masons, at $4.80 for 8 hours	$7.20	
½ day, 2 helpers, at $3.00 for 8 hours	3.00	
½ day, 2 carpenters, at $4.50, scaffolding	4.50	
Total labor		$14.70
2 bbls. cement, at $1.92	$3.82	
1 yd. sifted sand, at $3.00	3.00	
Total materials		$6.82
Total		$21.52

The total cost of finishing these walls was thus between 15c and 16c per sq. yd.

Residence at New Canaan, Connecticut, of William A. Boring, Architect, New York City

An Architect's Own House — Concrete Walls and Floors[1]

By Milton Dana Morrill

William A. Boring, architect, New York City, selected reinforced concrete construction for his country residence at New Canaan, Conn., although a majority of the important works of the firm of Boring and Tilton have heretofore been carried out in brick and stone.

W. G. Wood, a progressive builder of Norwalk, Conn., had launched out into poured concrete for residence work, as he saw in this type of construction the greatest future. Mr. Boring watched the work going on and visited the concrete houses after their completion. He had to be "shown" and did not adopt concrete without due thought and consideration, and from cellar to garret in winter and summer he went through the houses which Mr. Wood had put up.

He decided that poured concrete was the construction which he wanted, and as a result he has a permanent, fireproof house and he built it at a cost little in excess of that of the usual wood construction.

The plans here shown need little explanation, and the illustrations from photographs give one a good idea of

Fig. 3—Front and Side Elevations and Section

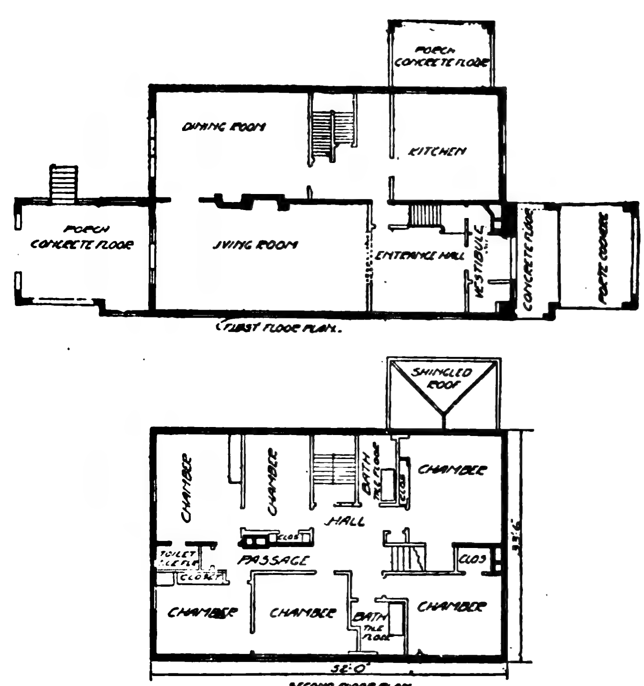
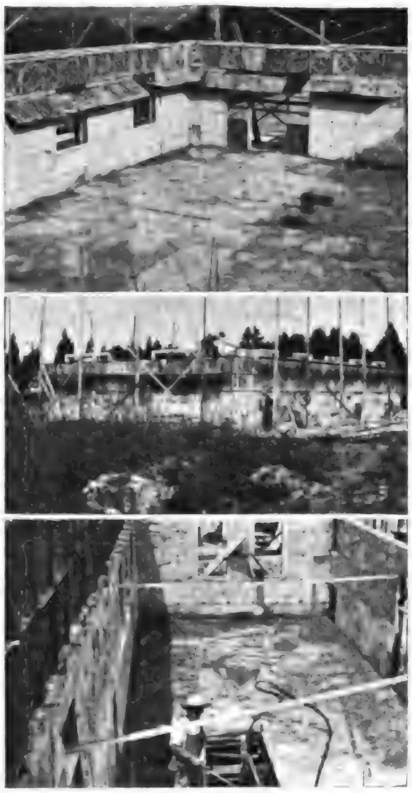


Fig. 4—First and Second Floor Plans, Boring House

[1]From Concrete, Jan., 1916, p. 19.



FIGS. 5, 6 AND 7 — CONSTRUCTION VIEWS, BORING HOUSE

At top, lifting a tier of wall plates; center shows frames set in forms; bottom view shows offset for second floor bearing.

the exterior design. As time goes on the house will become more and more attractive, as the trees, shrubs and vines, which Mr. Boring included in the archi'ectrual design, mature.

The house is of concrete throughout. The walls are 9″ thick in the first story, 7″ in the second, and 6″ in the third, with reinforcement, generally of 3/8″ rods 24″ o. c. The partitions are of concrete 6″ and 4″ in thickness. Both walls and partitions were poured by the use of steel forms;[2] the floors are of reinforced concrete of the floor-tile construction.[3] The slab thickness between the concrete beams is 2″. Beams are 8″ deep, spaced 20″ o. c. The house has a shingle roof, which would appear to be the only vulnerable part. The walls were furred for lath and plaster.

There are many individual touches about the house which must be seen to be appreciated. Living room, hall and dining room are all finished in chestnut paneling, which extends from floor to ceiling, stained a deep brown. For the second floor construction the forms were made of heavy chestnut plank laid over heavy wood beams all rough-sawed; the concrete floor slab was put over this, but the wood framing and beams were left as a finished ceiling, all stained a deep brown like the side wall paneling. The effect is very pleasing. Wherever in the house there is plastering, a sand finish has been given and the tool marks and trowel marks have been left to give texture to the finish. Hardwood floors have been laid over the cement slabs, except in the kitchen and the servants' quarters, where the floors have been left with a cement finish. The exterior walls have a rough stucco finish of white portland cement and sand.

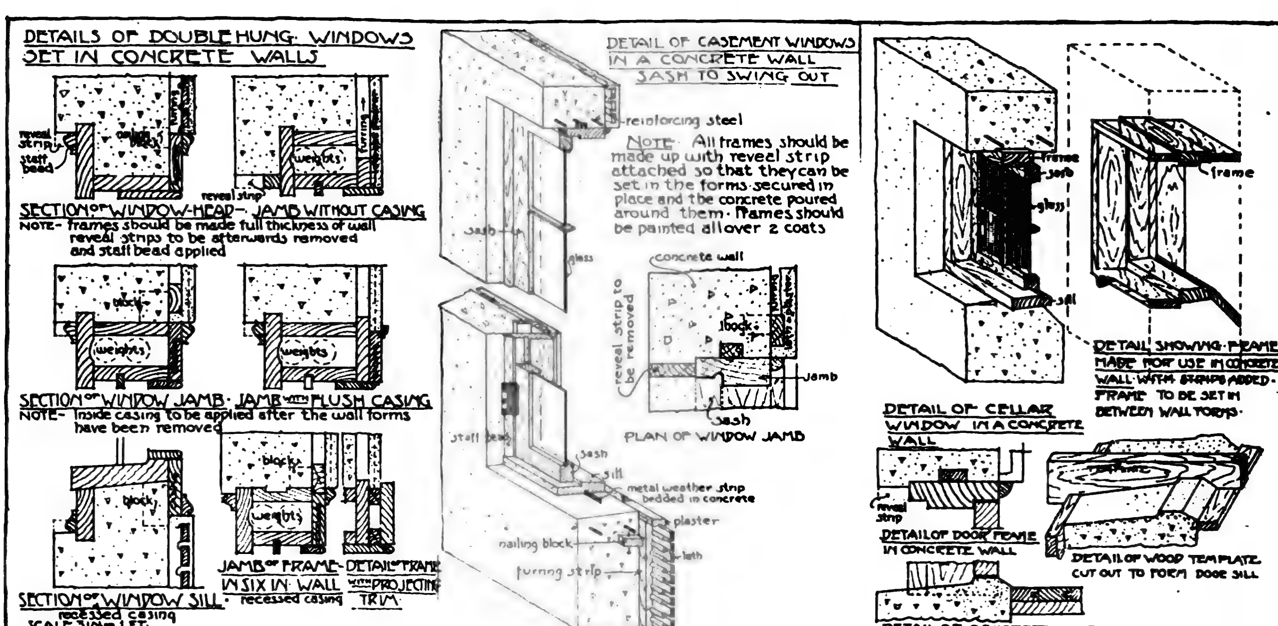
Besides the house there is a garage and cow barn, all built of poured concrete inside and out.

The cost of the concrete in place, including all form costs, was about $6.50 per cu. yd.

FIG. 8—LIVING ROOM, BORING HOUSE

Note beamed ceiling.

Mr. Boring's house is a masterpiece of its kind. In its simplicity perhaps lies its greatest charm. One can picture how beautiful it will become as the years take off the new look and bestow that indescribable coloring and texture which time alone can give.



SOME SIMPLE DOOR AND WINDOW FRAME DETAILS SUGGESTED BY MR. MORRILL FOR MONOLITHIC CONSTRUCTION

FIGS. 1 AND 2—TWO VIEWS OF HOUSE OF MR. MASSEY AT MIDDLEBURG, VA.

Two Houses of Poured Concrete at Middleburg, Va.[1]

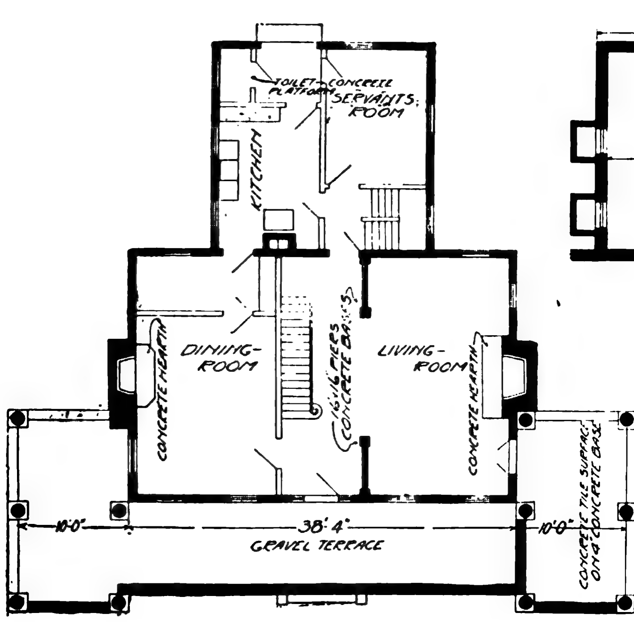
The accompanying plans and illustrations of houses at Middleburg, Va., with data as to construction, are presented through the courtesy of Milton Dana Morrill. The construction is similar to the work on the Thomas estate, described in another article.

Plans and illustrations from photographs shown here are of residences for G. Gordon Massey and for E. W. Murphy. The poured concrete walls of these houses have a thin stucco finish. The floor and the roof construction in both cases is of frame.

The house for Mr. Massey was designed by Milton Dana Morrill and built by Claude H. Haga, contractor. The foundation walls are of concrete wtih field stones bedded in the mix, the thickness of the walls being 12". The walls above the second floor level are 8" thick. The reinforcement is horizontal only, with but from 2 rods to 4 rods of 3/8" size put in over openings in the wall. The concrete used was a 1:2:4 mix, the stone used being obtained from field stones crushed on the job. The walls are furred for lath and plaster, and in order to have nailing places for the furring, small wood nailing block were dropped in each day as the work progressed. Each of these block had a nail driven into it part way, and the block were dropped in 16" o. c. with the nail projecting down into the freshly placed concrete to hold them in position next to the inner form. The exterior walls were covered with a thin coat of stucco mixed with Atlas white cement[2] and sand in equal proportions. The porch is set in concrete tile. The entire house cost approximately $7,000.

The house for Mr. Murphy was designed by Claude H. Haga, and the work was finished under the direction of Mr. Morrill after Mr. Haga's death. The walls, as in the case of the Massey house, are 12" thick. Here the partitions are 8" thick. The only reinforcing is 1/2" rods placed over windows and doors horizontally. Reinforced slabs were used over the porches at each end of the house. Elsewhere the usual wood joist construction was used in the floors. This house was given a stucco finish, thin like that on the Massey job, but after this had been put on it was washed down with white cement and water, which was tinted with ochre to give the walls a mellow tint. There was an old stone house on the Murphy house site and the old stone was crushed and used in the new building. Field stones were also

[1]From CONCRETE, Jan., 1916.



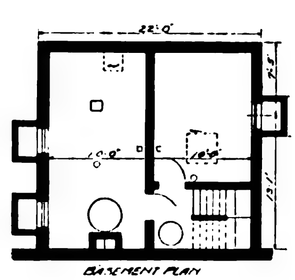


FIG. 3—FIRST FLOOR PLAN AND BASEMENT PLAN, MASSEY HOUSE

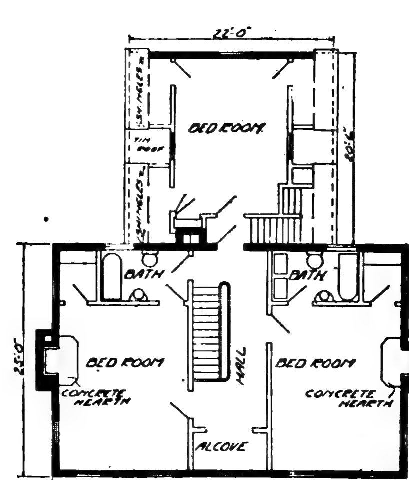


FIG. 4—SECOND FLOOR PLAN, MASSEY HOUSE

FIG. 5 (AT LEFT)—HOME OF E. W. MURPHY AT MIDDLEBURG

FIG. 6 (ABOVE)—REAR VIEW OF WALL COTTAGE AT HUNTLAND, ESTATE OF J. B. THOMAS, MIDDLEBURG, VA.

utilized in making the concrete. Interior walls were furred for lath and plaster and pipes were placed in spaces formed by the furring. All radiators are concealed in recesses under the windows, this being possible owing to the very thick walls. A construction of this kind, while not ordinarily economical in such great wall thickness, was felt by both Mr. Morrill and Mr Haga to be so in this case, due to the experience which they had had in building houses on the Thomas estate. It was found that with thick walls, where it was possible to bed a large amount of field stone in the concrete, it was just as cheap as thin walls which had to be heavily reinforced.

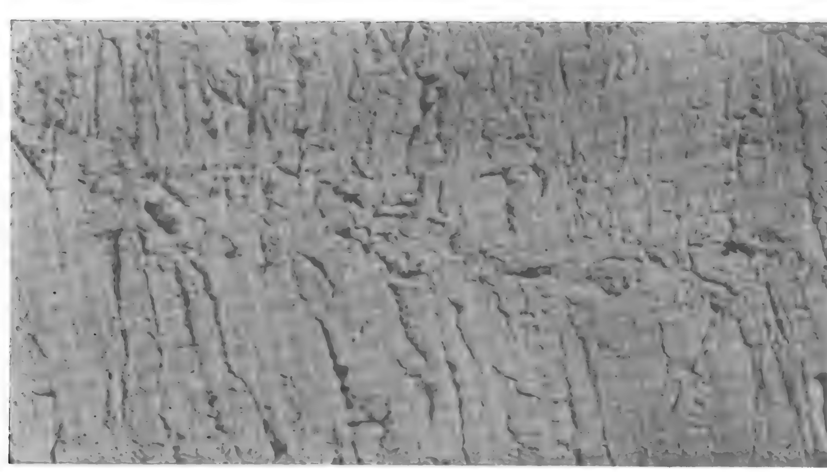
On both of these jobs the forms were handled in such a way as to use two tiers of forms, or a total form height of 4′, and pour one tier a day. The lower forms were taken off each morning and swung up on a frame, so that they were handled together in long strips and in the new position were filled again. Thus the two tiers alternated every two days. The concrete was handled in wheelbarrows to 4′ above grade. Above this height pails were used as far as the second floor lével, the pails being handled in wheelbarrows four at a time and taken to different parts of the building and passed up to the tops of the forms by hand. Above the second floor level the pails were hooked to a grapple four at a time, and raised to the form level by a drum on the mixer. They were then carried by hand. No staging was necessary, as the floors followed the walls, nor was any staging or outside scaffold used in handling the forms. The average labor cost for cleaning and fitting the steel forms was 1 ct. per sq. ft. of form surface, or 2 cts. per sq. ft. of wall. In both cases the exterior stucco finish was put on about 60 days after the walls were up. The stucco is very thin, in some places not more than 1/8″ thick. The illustration of this stucco surface, shown on another page, indicates slight crazing, but this view is from a photograph taken at very close range, and, owing to the rough texture, the crazing is not objectionable, in appearance, at least, and it is believed that the walls are so nearly waterproof in themselves as not to need the stucco as a seal coat. Stucco put on in this same way more than 3 years ago shows no signs of peeling. It is only with very true forms and smooth cast surfaces that it is possible to use so thin a stucco to smooth up a wall.

Two Cottages Near Middleburg[1]

The houses shown in the accompanying illustrations from photographs and floor plans, were built by Claude H. Haga at Huntland, on the estate of Joseph B. Thomas, near Middleburg, Va. They are a part of very extensive concrete work, the stucco surfaces in one coat being of special interest.

The houses are at the entrance of the Thomas estate, one for a lodge and the other for the residence of the gatekeeper. The front walls of both these houses are continued in the walls of the estate.

One of the cottages has 12″ walls poured in steel forms — the Morrill system, using shallow pan sections 2′ x 2′. The first story has a ceiling height of 8′ 6″ and the second story is 4′ to the rafter plate. Walls and chimneys contain approximately 95 cu.



STUCCO SURFACE OF COTTAGES BUILT BY MR. HAGA

[1]From CONCRETE, Jan., 1915.

yards. of concrete. The mixture used was 1 part cement to 4 parts sand, poured wet, and then filled in with field stones—all that the wet mortar would cover as the work progressed. Mr. Haga is of the opinion that 50% of the bulk of the wall is made up of fieldstones. The only reinforcing used consisted of bars placed around openings and in the fireplaces and chimneys. Chimney flues are of terra cotta and the steel forms were used in part in buliding up the chimneys, the taper being given by a wedge-shaped wood form section, moved upward as the work progressed. The fireplace was made with wood forms on which a steel throat rested. On this throat the flue lining was started. The fireplace was later lined with firebrick.

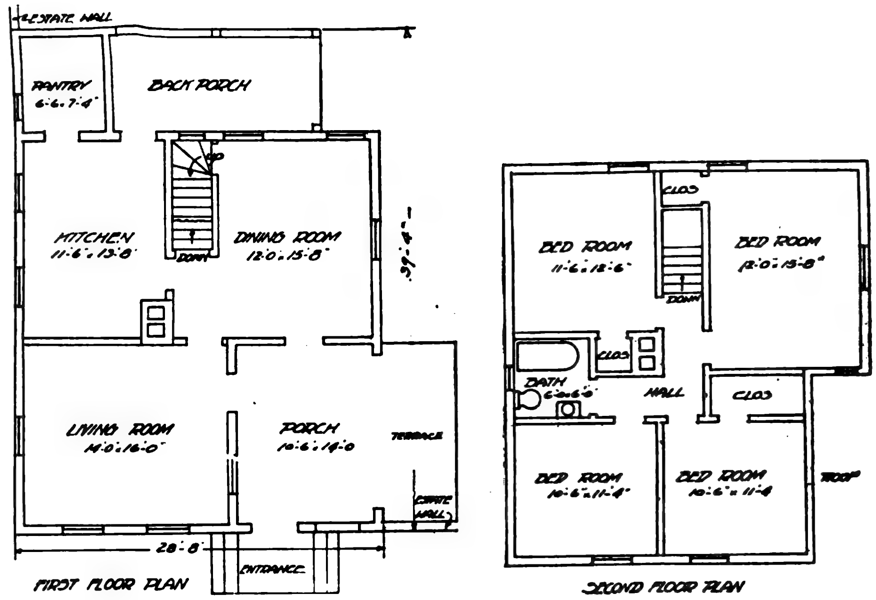


Fig. 4—Plans of $2,700 Cottage with 8-in. Walls, Near Middleburg, Va.

Ground floor joists have their bearing on a ledge of the foundation walls, which are 16″ thick, except in the cellar section. The ceiling joists are fastened by joist hangers, held in turn by a 2″ x 8″ timber, which is bolted to the walls. Mixing and placing the concrete were done by hand, but in placing the field stones they were dropped into the forms direct from wagons which brought them in, until the wall was above a height of 8′.

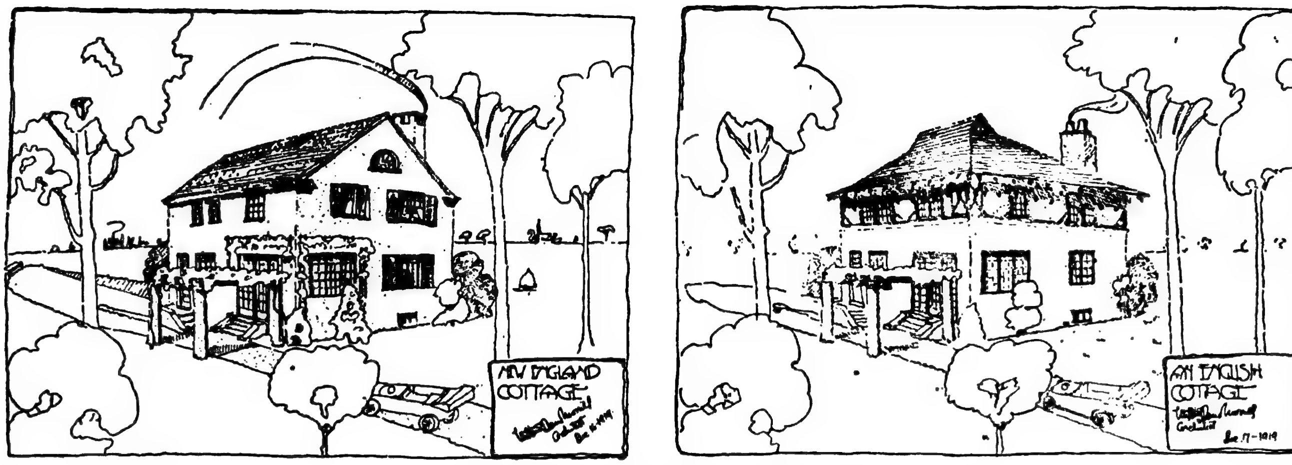
Mr. Haga figures form setting and removing on this house at $60.

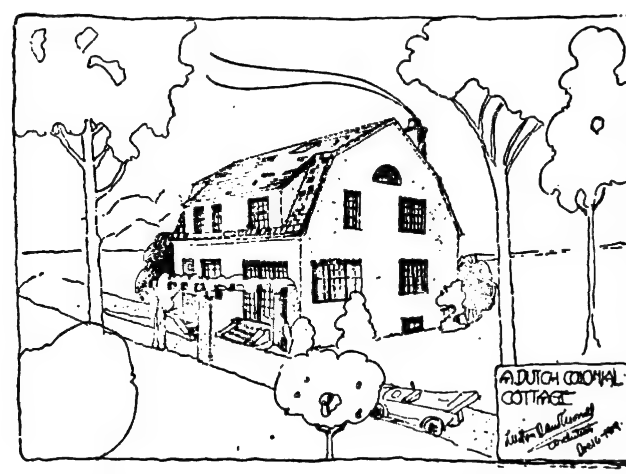
The other house has 8″ walls of 1:2:4 mix, cement, sand and stone, and because of the thinner walls is much more strongly reinforced. It was also poured in steel forms. Both houses were built at about the same time and in connection with estate walls and various small outbuildings, Mr. Haga figures the cost of the 12″ wall house at $2,450 and that of the 8″ wall house at $2,700.


Fig. 3—Concrete Cottage with 8-in. Walls Built at a Cost of $2,700—See Plans in Fig. 4

The Easy-to-Keep House

DESIGNED BY MILTON DANA MORRILL
ARCHITECT, NEW YORK CITY





FIGS. 1-3—THREE TREATMENTS OF ROOF LINES FOR SAME PLAN

A number of new and interesting features characterize the house shown in the accompanying plans and details.

It is a house designed to meet the particular conditions in these high-cost-of-living times, its designer maintaining that the measure of happiness and contentment people get out of life depends to a large extent on their ability to adjust themselves and their ways of living to the new order of things. This new order involves not only the high cost of living, but also the extreme likelihood of the servant class becoming extinct —that as a result, people will keep their own houses and therefore will want them simple.

This is the main idea of the "Easy-to-Keep House." It is designed to be built with monolithic concrete walls by the Morrill system and it is shown in the illustrations in three possible treatments of the roof line, suitable for group construction in suburban development without sameness.

It is in the interior that the prospective builder will find some of the most interesting features.

The kitchen of the "Easy-to-Keep House" is planned to save steps. Almost everything is to be within reach—from the spice box to the broom.

There are sliding racks in the space between kitchen and dining room, in which to set the dishes. These are rinsed with scalding hot water on the kitchen side and allowed to drain and dry, just as is the custom in hotels, and are all ready in the rack, accessible from the dining room. The designer of the house discards the idea that human labor in the home is cheap, and therefore time-saving devices are not to be considered. The details of the racks for silver and dishes, both of which slide from dining room to kitchen and back again, and other cupboard details illustrated, will interest any housewife, and there are a number of other features of this cupboard of special interest that are shown in the details.

There is a swinging seat under the work table. There is a food pantry with an air-cooled closet to save ice in the fall and winter months. The drawers for kitchen and table linen are set on rollers, so that they work as easily as office filing cases.

The stairway of the house, a central feature, is built more like a piece of furniture than a fixture of the

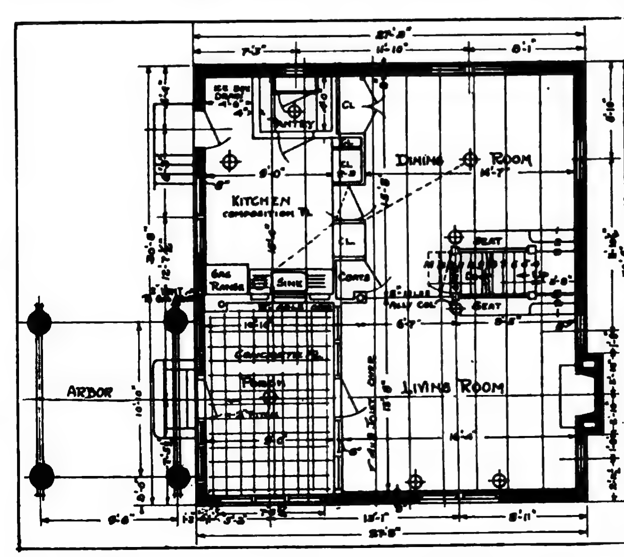


FIG. 4—FIRST FLOOR PLAN, THE "EASY-TO-KEEP" HOUSE

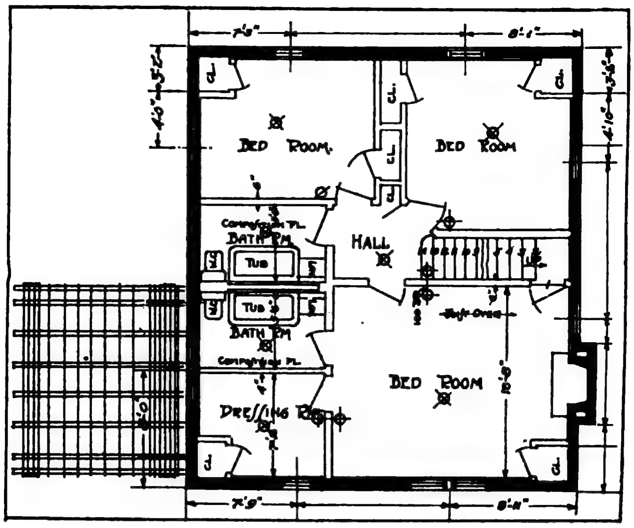


Fig. 5—Second Floor Plan, Morrill "Easy-to-Keep" House

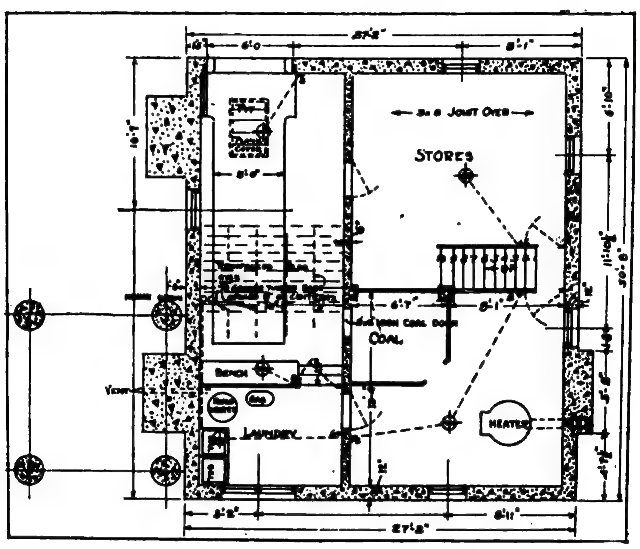


Fig. 6—Basement Plan with Garage

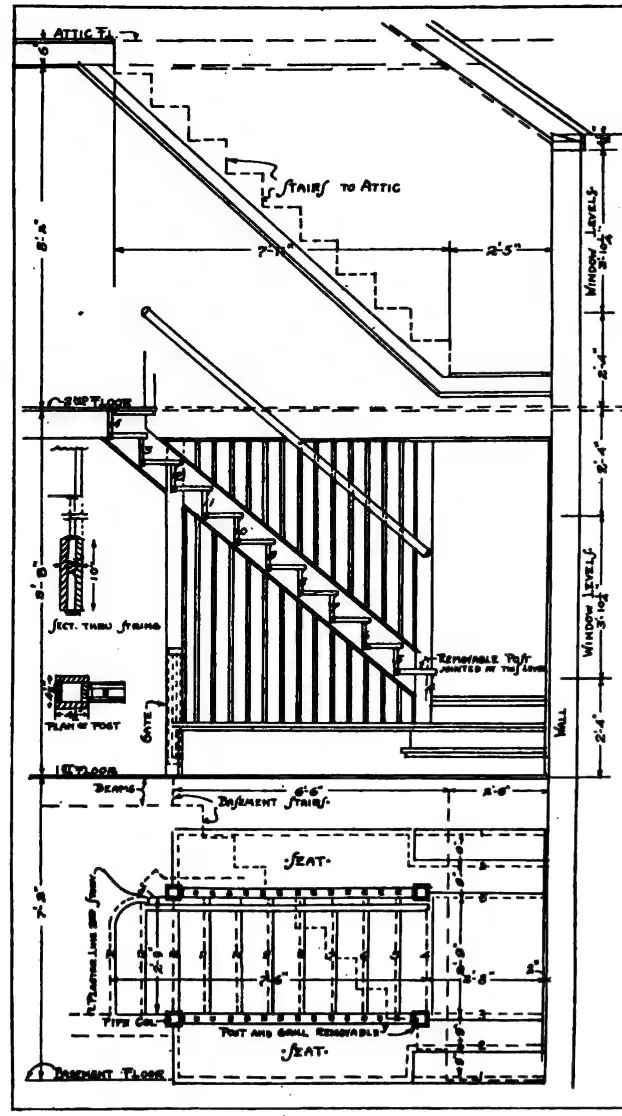


Fig. 7—Stair Detail

house. This staircase is specified to be made of cypress and finished as shown in the details. It stands open in the room and the under sides or steps are exposed to view; risers and treads are screwed together so as to give a neat appearance on the under side. The spindles of 1" square cypress are secured to a panel strip at

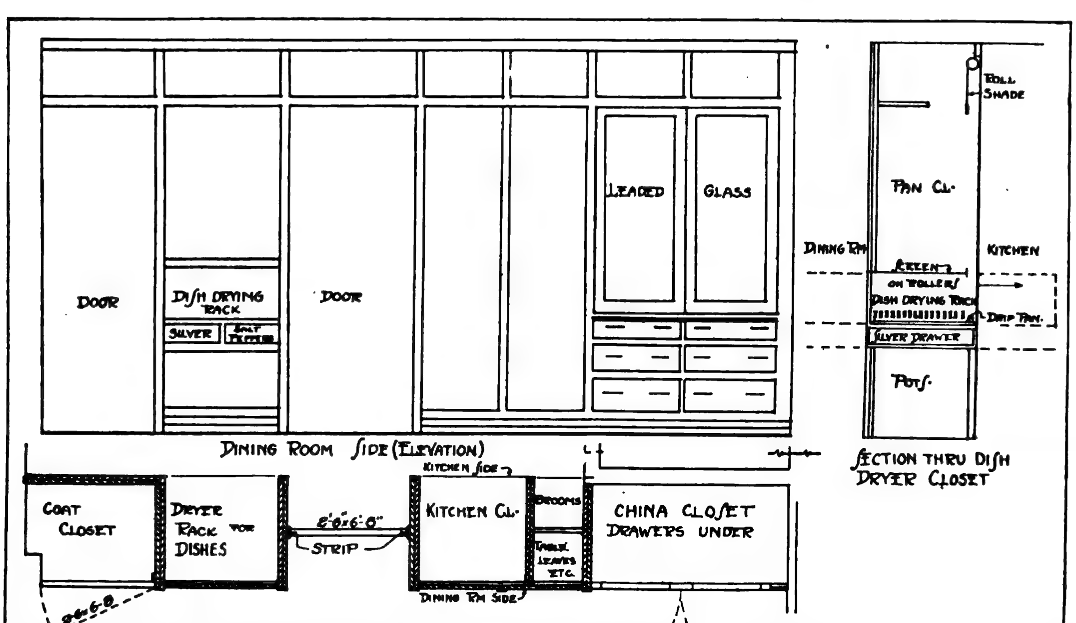


Fig. 8—Details Cupboards

top and bottom, and the spindle panel on the living room side is removable, as is also the post at the foot of the stair—a help in getting furniture up and down.

Aside from these features, there are interesting things in the general construction of the house.

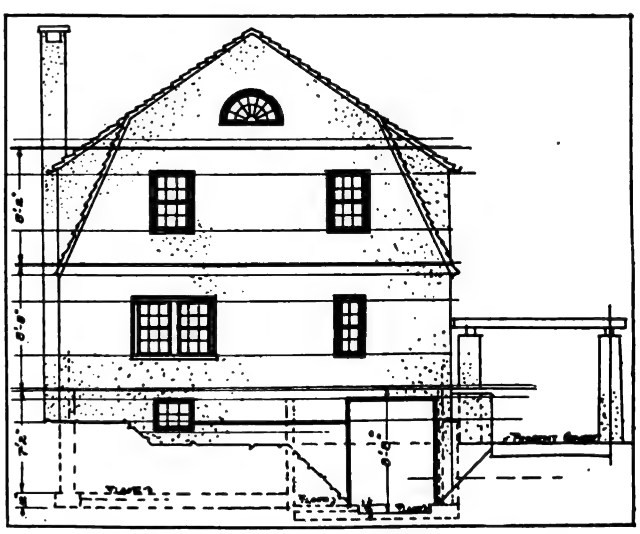
It will be noticed from the details that the excavation of the house is to be 4′ below grade; that the first floor is to stand 2′ above the natural grade. The excavated material is to be used in grading up the front portion of the lot in a terrace 2′ above natural grade, while the drive at the side is to be graded downward to give access to the basement garage by an easy slope.

The footings, foundations, exterior walls, including the face wall of the long dormers, the basement partitions, chimney, basement floor, floor slab over the garage and the garage floor and drain pit, are to be of concrete, as are also the porch columns, the front and back steps.

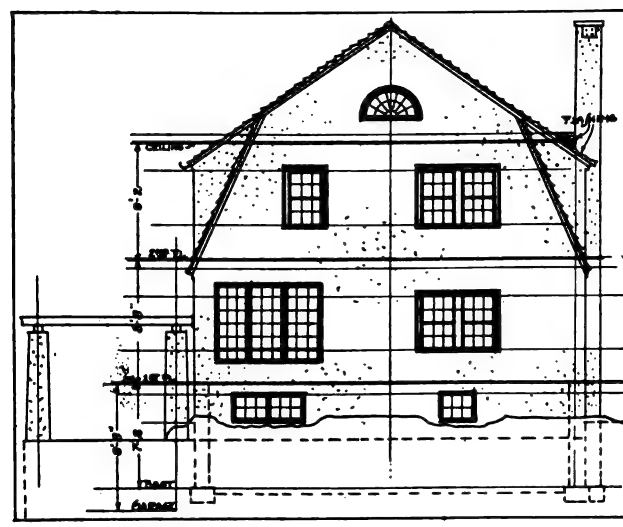
It is in the specifications that the contractor is to be furnished with a 20-mold outfit of Morrill steel forms on a rental basis.

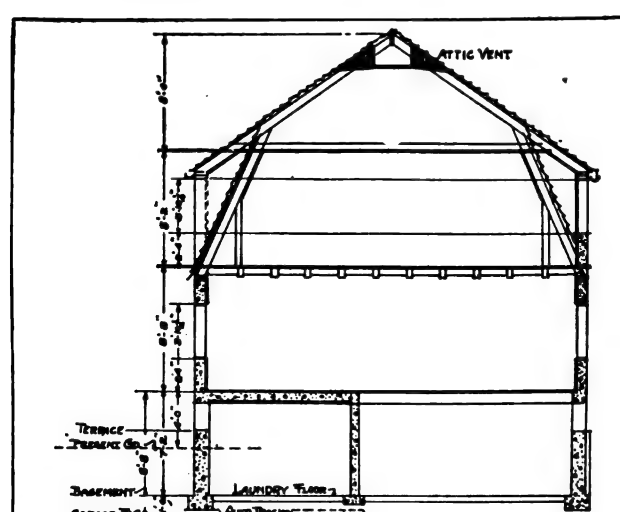
The concrete walls are to be built up in courses generally 20″ high at a time. The top of the wall to be well wetted before new concrete is placed. The steel forms are to be lightly tapped with a hammer as soon as they are filled, to settle the concrete compactly into place. At the end of each day's work bulk head boards with a triangular bond strip are dropped into the forms to bring the course of the finished concrete to a vertical line. The next morning the board is to be removed, leaving the recess bond for the new concrete.

Concrete walls are to be reinforced with 3/8″ steel



Figs. 9 and 10—Front and Entrance Side Elevations





Figs. 11, 12 and 13—Chimney Side, Rear, and Sectional Elevations

bars spaced 2′ apart horizontally, except in heights where window frames come, and a vertical bar placed on each side of window and door frames. In addition, there is to be an additional bar directly above all window and door frames, these bars being at least 3′ longer than the openings are wide.

The porch and the kitchen are to have reinforced concrete slab floors of 1:2:4 cinder concrete 6″ thick, with rods in both directions, as shown in details. The porch floor is to be finished off with a 1/2″ topping of

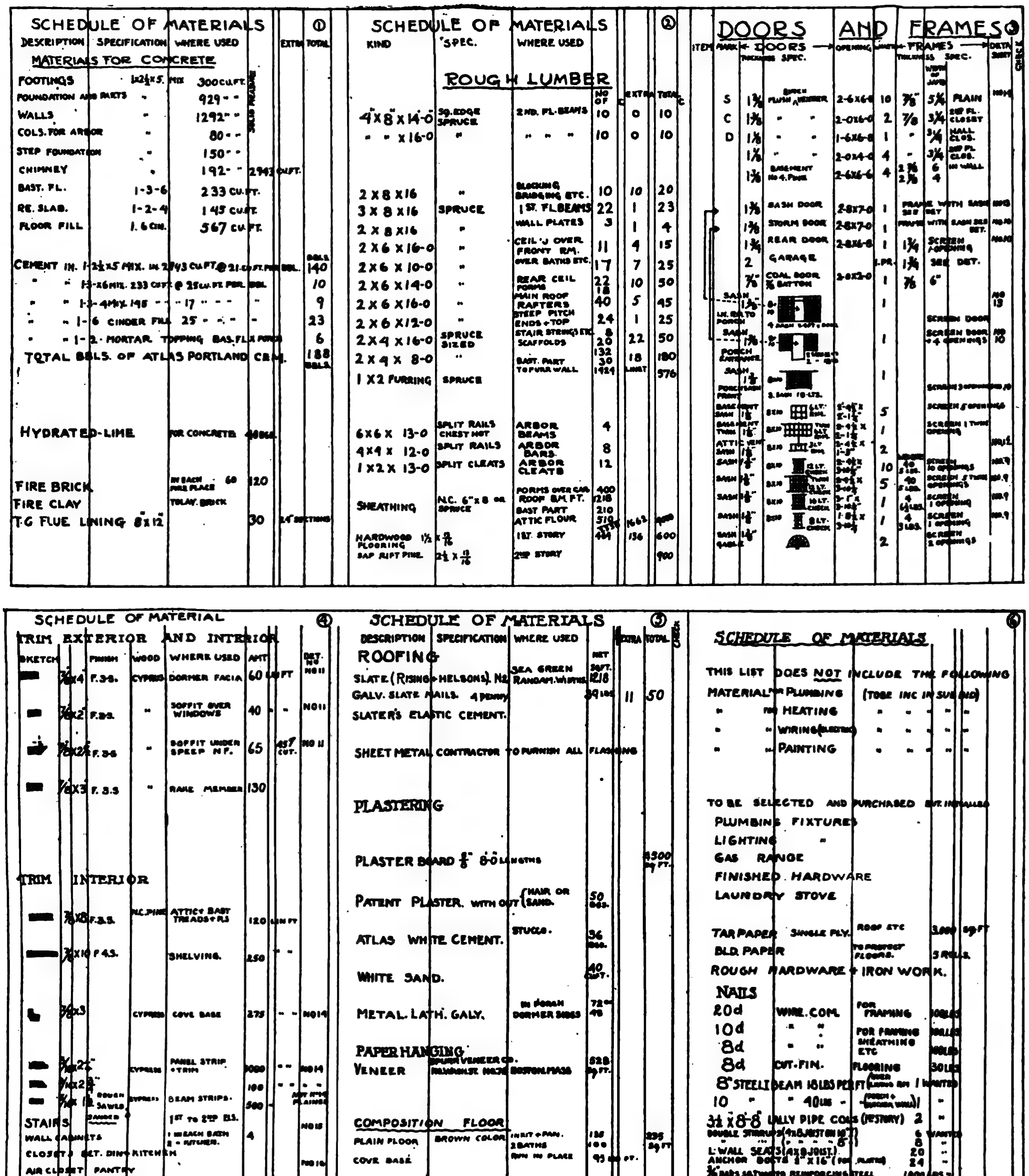
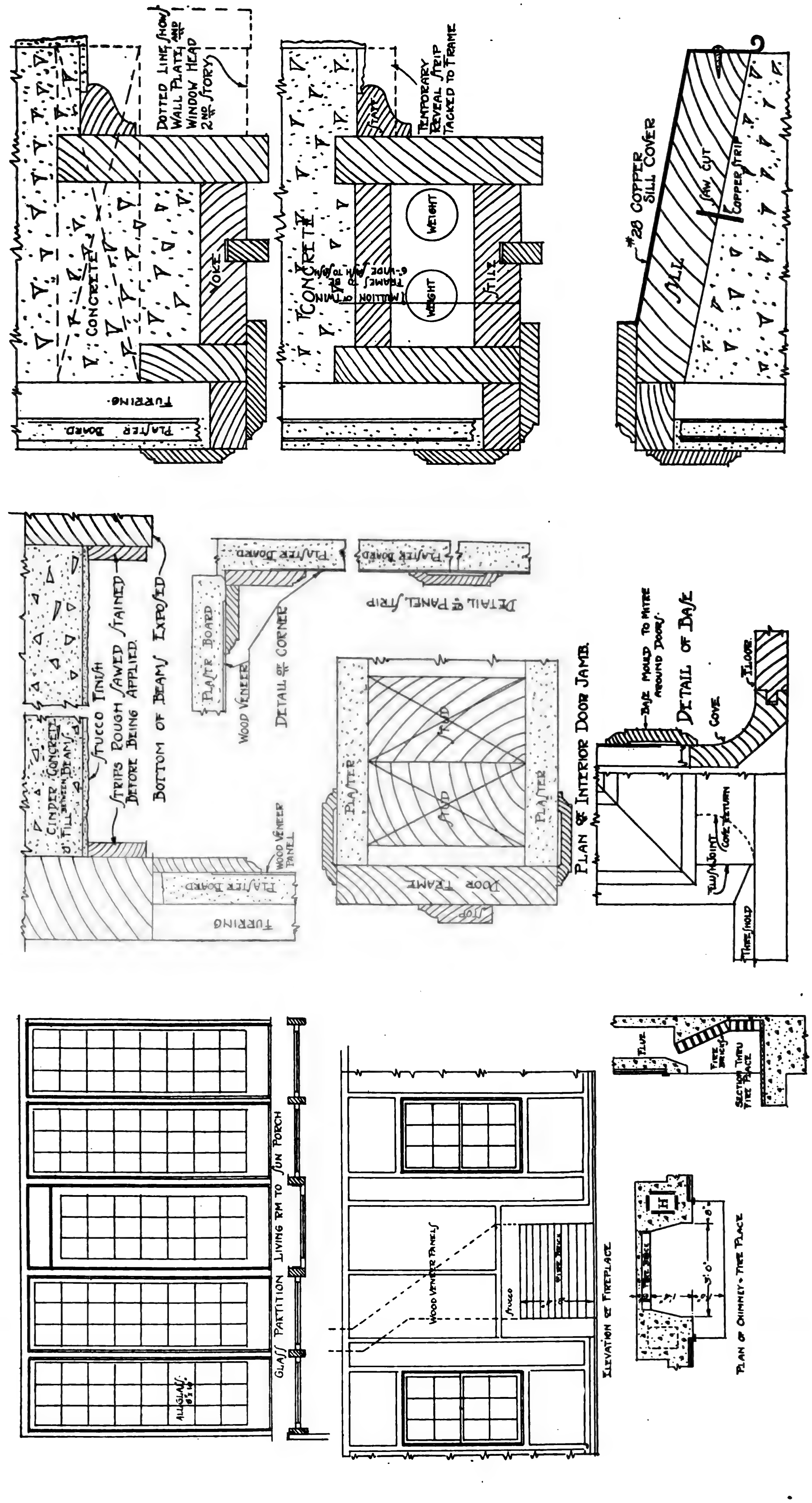


Fig. 14—Bill of Materials, Morrill "Easy-to-Keep" House

red 1:2 mortar, troweled down and ruled off in 12" squares.

The spaces between the 4" x 8" spruce beams between the first and second stories is to be filled with cinder concrete, made up of 1 part cement, 1/8 part by volume of hydrated lime and 12 parts of coal cinders, to pass through a 3/4" mesh screen. No sand is to be used in the beam fills. Window and door frames are to be made up as shown in the details, with pulley styles, and to be of pitch pine 1 1/8" thick. All frames to be made to fit stock sash; all glass to be 8" x 10". Frames are to have saw cuts to receive copper weather strips at the job. The frames are to be finished and built out with temporary reveal strips around sides and top to the thickness of the walls, so as to be ready to put in place in forms. All interior door frames are to be of cypress 7/8" in thickness. Frames for basement doors are to be thoroughly cross-braced inside, so that they can be set into the forms and the concrete can be molded around them. Two-inch screws are to be started in backs of frames, heads projecting to be embedded in concrete to secure them to concrete.

After the 4" x 8" floor beams are placed, forms are to be dropped in between the beams to receive cinder concrete sills. Spikes are to be driven into the sides of the beams and heavy wire is to be laid across the beams and attached to these spike heads. These rows of crossed wire bridging are to be spaced not more than



FIGS. 15, 16 AND 17—VARIOUS DETAILS, MORRILL "EASY-TO-KEEP" HOUSE

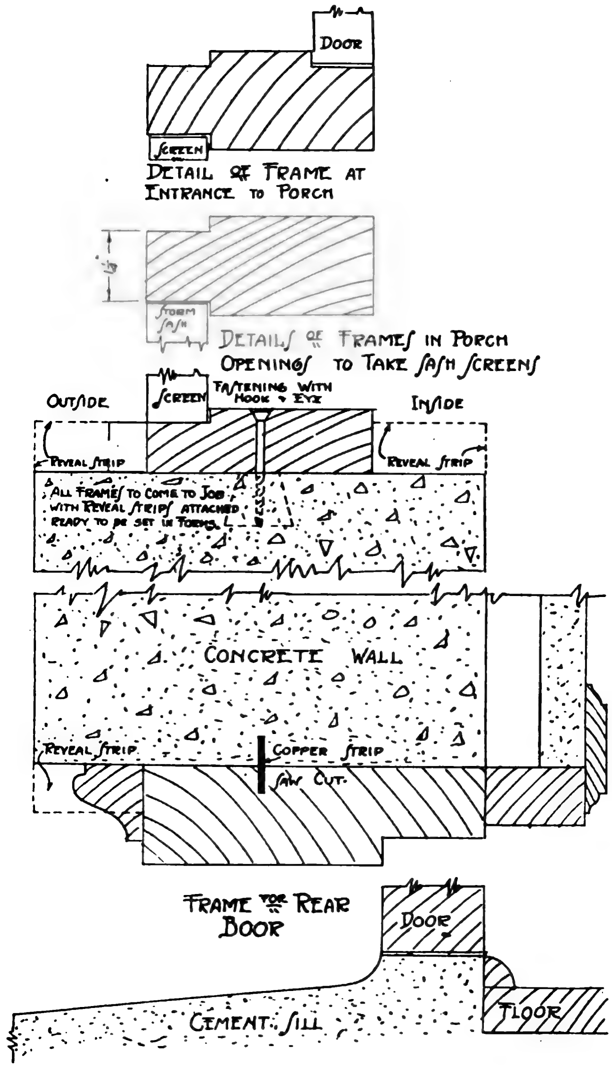


Fig. 18—Details Morrill "Easy-to-Keep" House

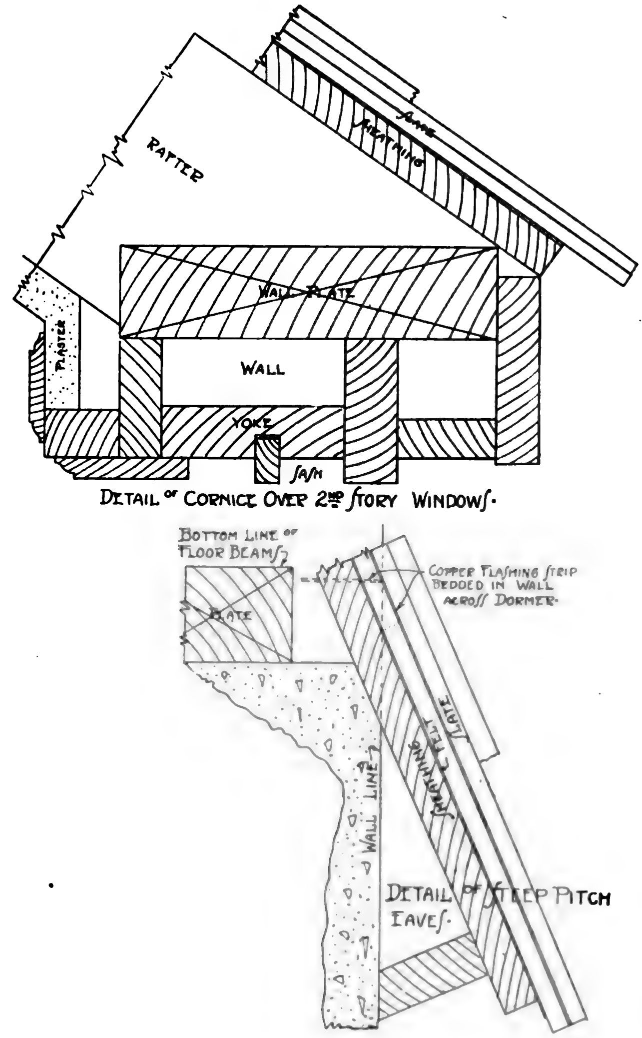


Fig. 19—Details Cornice and Eaves, Morrill House

3′ o. c. When the cinder concrete fills are placed, the carpenter shall see that the nailing strips are placed between the 4 x 8 beams, to give proper nailing for floors, base and so on.

The concrete walls, except in closets, are to be furred out with 2″ x 2″ strips, properly spaced to give secure nailing for plaster board, which is to be used instead of the usual plaster finish.

The ends of dormers are to be covered with galvanized wire lath over tar paper, the lath to be stripped out so as to give a proper bond for stucco. The concrete walls themselves shall have but one coat of stucco on all exposed surfaces, including columns, porch interior, face of fireplaces and sides of steps, under side of cinder fill concrete between floor base over living room, dining room and sun porch. This shall be finished with one coat of white cement stucco, like sample to be made in advance and approved.

This stucco to be mixed 1 part white cement, 1/10 part by volume of hydrated lime, 2¼ parts of white sand, the sand to be mixed with a small portion of Jersey gravel or yellow sand, to give a cream tone to the stucco. This one coat shall be put on as thin as possible, from ⅛″ to ⅜″ in thickness. It shall be applied with a steel trowel and shall be left with the trowel marks showing.

Inside, the walls shall be finished with plaster board on furring strips throughout. The plaster board shall be ⅝″ thick and in 8′ lengths, to be solidly nailed at bearings and to be cut neatly at joints, the joints to be filled with a quick setting plaster. On the first story the plaster board panels are to be covered by a mounting of a thin veneer of wood on paper by the paperhanger. On the second story the walls and ceilings are to be finished over the plaster board with a coat of brown mortar, with selected colors of brown sand or Jer-

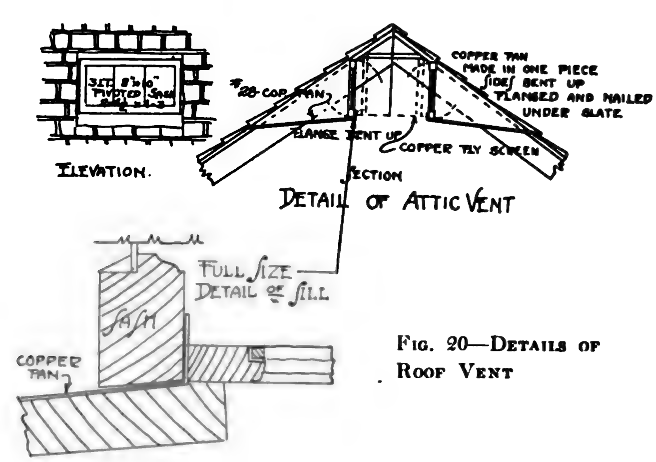


Fig. 20—Details of Roof Vent

sey gravel; this is to be floated up and left in sand finish; the walls of kitchen and bathroom are to be plastered in Keene's cement troweled to a smooth uniform surface. The ceilings in these rooms are to be a white coat over plaster board.

The roof of the house is to be a sea green slate, in random widths.

STRAIGHT LINES, SIMPLE ARCHES, PLAIN SURFACES, AND THE DRAPERIES OF NATURE—AN IRVING J. GILL HOUSE

Economy and Simplicity in Concrete House Building[1]

By Reed Robinson

The essence of art is simplicity. Only the true artist can afford to be simple, direct and unadorned in his creative work. Art production consists mainly in the elimination of the non-essential.

American architecture is a curious thing, since it is not distinctive as such. Indeed, the phrase "American architecture" is almost an anomaly, since to a considerable extent it is bound to conventionality. Irving J. Gill, San Diego, Cal., is an American architect who has no use for conventionality. His architectural creations are practical art, distinctive and individual. He has boldly and broadly forsaken conventional architecture.

Mr. Gill's specialty is the creation and erection of habitable homes. For a quarter of a century he has devoted his talents to designing and building beautiful homes in sunny southern California. And his work has been pronouncedly individual. It has been artistic and utilitarian.

Mr. Gill has deliberately limited himself to the cube, the hemisphere, the rectangle and to segments of circles in developing a style of architecture which is not only unique, but beautiful and practical as well, in its simplicity. Possibly this is the American architecture looked for as distinctive of the country, yet found generally only in towering skyscrapers.

The plain surface, unbroken by cornice or window ledge, the severe arch without column as support and a rectangular skyline, relieved only here and there by the curve of an hemispherical dome, or the graceful and casual figures of a growing vine, are the contours and surfaces used exclusively in the Gill designs.

[1]Abstract from CONCRETE, Apr., 1914, with illustrations from January, 1917.

Another feature which Mr. Gill makes a distinctive point in his work on residences, is the effect of reflected colors upon a white or a neutrally tinted, unbroken surface. To the discerning observer of color the plain white surface is composed of delicate and changing hues which takes tones from the greens of the lawn or tree, the blue of the sky and the multiple shades of the varied flowers. The splashing warmth of crimson from a geranium bed, together with the varied lighting of morning or afternoon, clear or cloudy weather, produce effects upon these walls that are a delight to the eye.

This idea of reflected colors is employed by Mr. Gill not only in connection with the outside walls, but in planning the lighting of interior rooms. The walls are designed with surfaces as flat and unbroken as possible. They are finished in a plaster surface slightly roughened. The ceiling is tinted a light neutral shade. The side walls are tinted likewise, though the color is a shade deeper than that of the ceiling. The result of this treatment is such that ceiling and walls take on the hue of the dominant color note in the furnishings. This makes the rooms especially delightful to the eye and extremely restful for the occupant in the matter of light and color. This idea is characteristic of every Gill house.

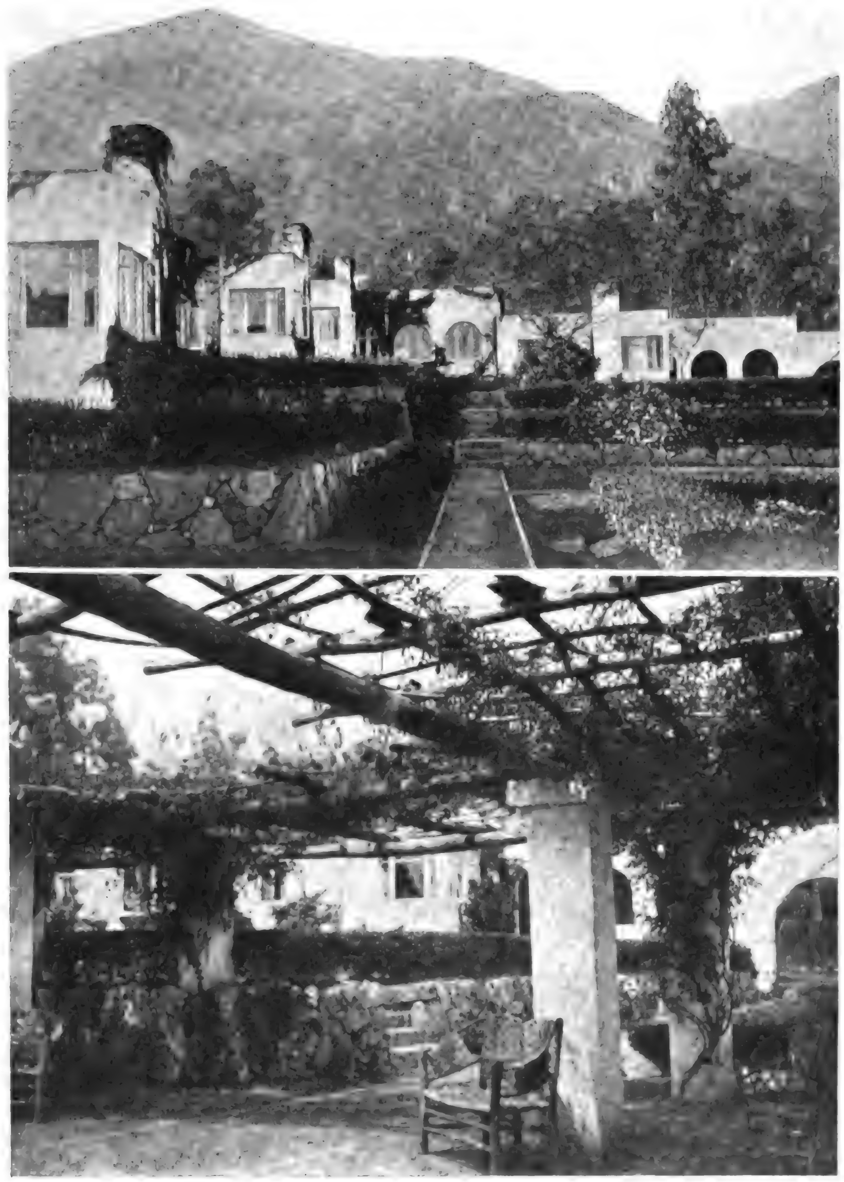
From the standpoint of the owner it is eminently satisfactory to note that a Gill house is much cheaper than that of most others. The comparatively low cost of the Gill houses is largely due to the fact that concrete is the only material used and Mr. Gill's ideas of simplicity of line in architecture make the very most out of the material concrete. It is such use of concrete which is most characteristic of the material. Wood is employed but sparingly, and this for interior finishing of doors, windows, stairways, etc. Mr. Gill, by the use

of concrete, has been able to produce handsome and distinctive residences. By the use of concrete Gill structures are built at a cost lower than corresponding construction could be done with wood or other material.

In a general way Mr. Gill figures concrete in house construction at approximately 30 cts. per cu. ft. in place (1914). He figures the walls at 10% of the building cost.

In a typical Gill house wood forms were used for the entire construction — walls, floors, stairs and roof. The first floor and garden walls are 12″ thick and second story walls 8″ thick, with 3/4″ twisted rods for reinforcing 1½″ from bottom of slabs. The concrete stair slab is 4″ thick in net section and reinforced with 3/4″ twisted rods laid full length of the stairs at the sides of the stair. The roof is a 6″ slab reinforced with Hy-Rib. The walls are reinforced with Elwood wire fencing, 4″ triangular mesh, placed 1½″ from outer surface. In general a 1:3:5 mix of cement, sand and gravel was used. It is Mr. Gill's policy, however, to change the mix from time to time, depending upon tests of sample concrete from the materials available. Concrete was conveyed in wheelbarrows.

After the removal of the forms, the outer wall surface was smooth stuccoed with a heavy coat of a mixture of 1 part cement to 1 part sand, with a 5% admixture of hydrated lime.



EXAMPLES OF THE WORK OF MR. GILL

A special feature is that interior woodwork is finished flush with the walls in every part of the house. All doors, whether leading from room to room or into cupboards and closets, are built without panels and set flush with the casings, which, in turn, are flush with the walls. This feature makes a practically dust-proof house and eliminates a distressing item of housework. Not only that, it makes the rooms more sanitary.

Drainboards and backs of sinks are of magnesite. The magnesite slabs are finished flush with the walls. Corners where they meet the sink are rounded, eliminating cracks in which grease or dirt may collect and doing away with exposed wood to become sour and decay from constant wetting. Bathtubs are boxed, then covered with magnesite up to the porcelain tub edge and finished with rounded corners. Bathroom floors are of magnesite with all angles rounded. This construction in the bathroom renders it easy to keep clean and wholesome. In fact, there are no cracks, corners or crevices, projections or sharp edges in the entire structure.

The use of concrete in carrying out these ideas in house construction makes them practical because concrete as a building material is inexpensive, adaptable, reliable and lasting. Through the use of concrete Mr. Gill attains these effects at a saving of time, cost and labor, and with the certainty of satisfactory results.

Fig. 1—Fireproof Residence of George H. Taggart, Port Washinton, N. Y.

Fig. 2—Detail of Rear Entrance

Fireproof House at Port Washington, N. Y.[1]

The house on a hilltop in the accompanying illustrations, with its straight lines, simple arches and broad white surfaces set off by the trees which form its background and whose branches stretch out over it at the sides, is the new home of George H. Taggart, an artist, and Mrs. Taggart, of Port Washington, N. Y.

It was designed by the owners and occupants in a frank appreciation of the work of Irving J. Gill, the California architect, whose house designs in a new concrete architecture have several times been described and illustrated in Concrete.

The Taggart house, overlooking from an eminence a beautiful stretch of Long Island Sound, is in many respects unconventional. It has been worked out thoroughly from the standpoint of the most liveable grouping of rooms, enclosed in the simplest way by permanent fireproof construction, relying upon the restfulness and wearing qualities of simplicity and depending for relief of any severity in the newly finished structure by tapestries of nature, which time will add.

The house has concrete walls, floors, stairs, and roof, the roof being flat, surrounded by parapets; the portion over the studio (only one high story) being reached from a stairway inside, making a most enjoyable outdoor retreat that is a part of the house itself.

Inside, a great deal of tile and brick are used in floors, stairs, and fireplaces, and a minimum of wood trim. All angles of both walls, ceilings, and floors are coved. Plans and elevations are shown. The group of little pictures from photographs shows something of the work done by the owners to satisfy themselves in advance as to the final result. The plan was first worked out

[1]Concrete, September, 1919.

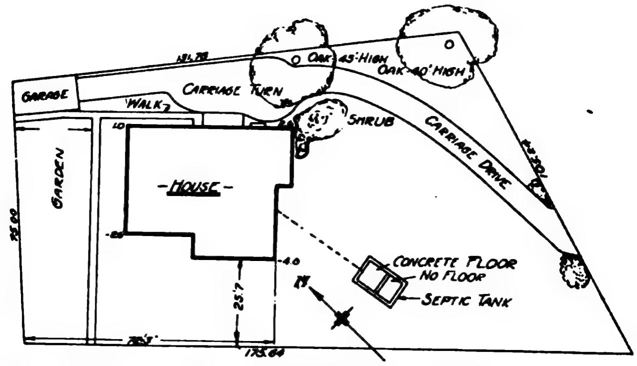


Fig. 3—Plan of Site of the Taggart Home

and adopted—then to enclose it in a way most pleasing, most economical and most in keeping with the site.

A half dozen models were built, each with plans identical, but with roof and elevation details varying. Three of these models are shown in the pictures. At the top, at the left of the group, are three views of one of the early models; below it is a view of a second model; and below that, at the right, are six views of the style which was finally adopted. The finished construction followed this model very faithfully.

The concrete construction was done by F. F. Wilson, a builder of Rockville Center, N. Y., who has been engaged in building suburban homes since 1891, and who for the last four years has been devoting himself wholly to reinforced concrete.

Fig. 4—Models Made by Mr. Taggart Before Building

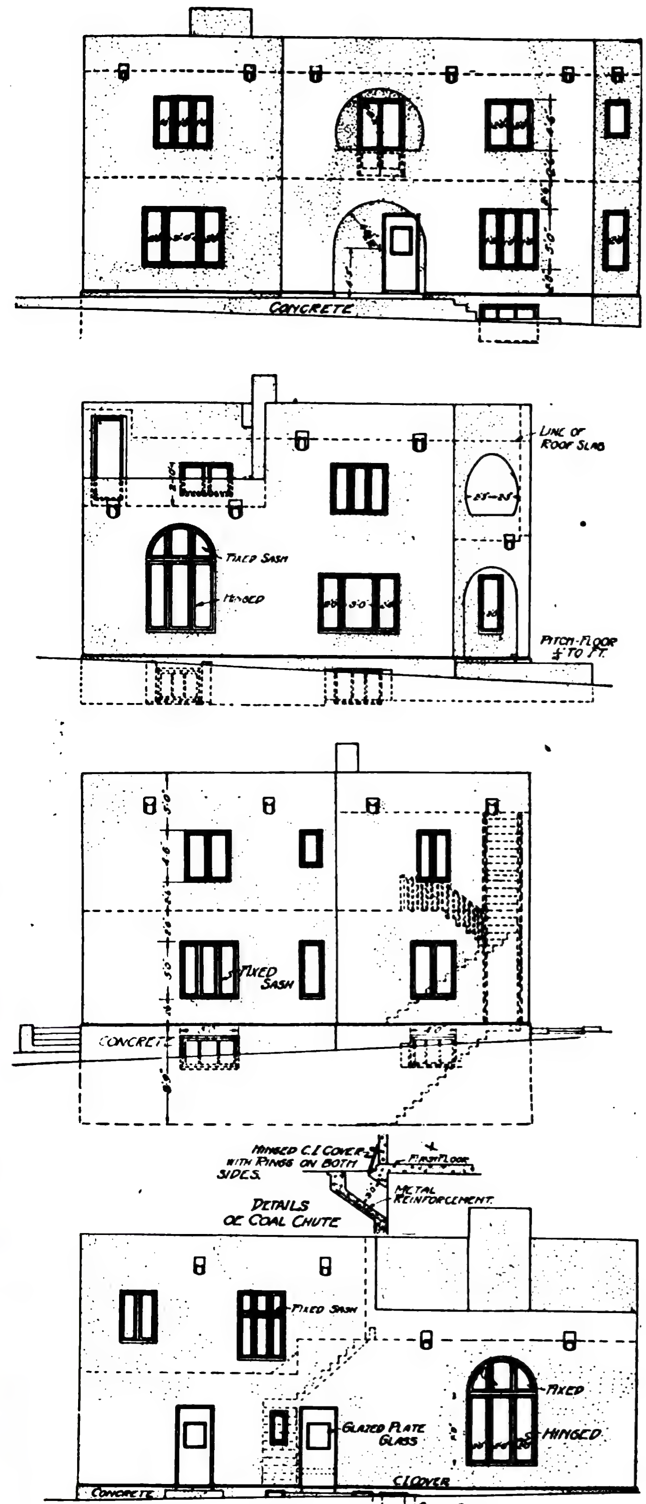
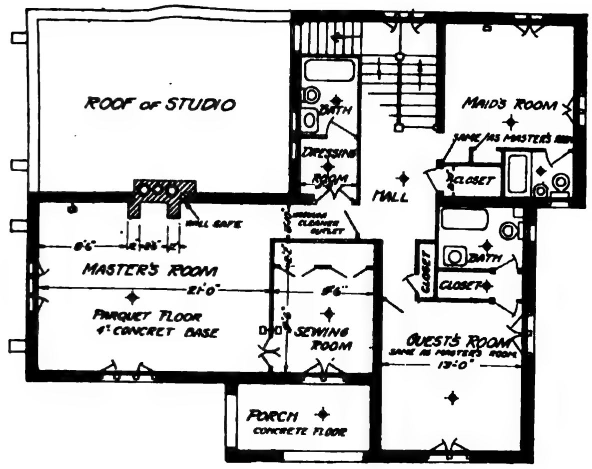


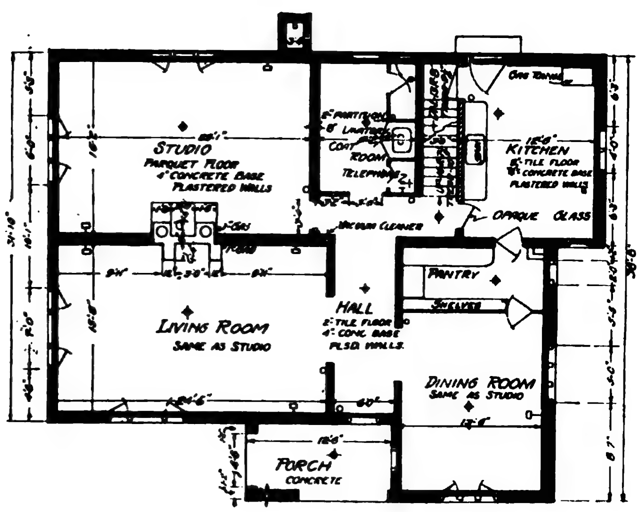
Fig. 5—Elevations Showing Extremely Simple Lines of Taggart House—The Effect of Trees with Such Simple Architecture Is Suggested in Figs. 1 and 2

Hydraulic pressed steel forms were employed and both floors and walls were cored with Sackett wall board domes.

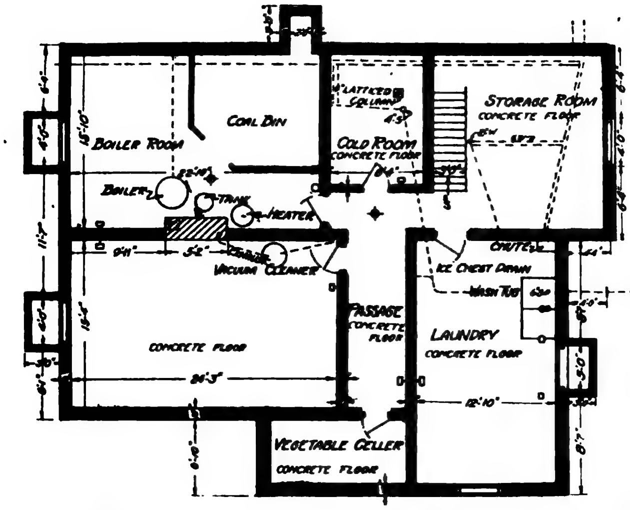
The location of the building was excellent and surroundings good, the soil, a gravelly loam, making a good foundation.

The foundation walls are solid, 12" thick; floors are 9" thick over all, with domes 2' wide, 3' long, with a 6" hollow space, the beams thus formed between the domes being 4" thick, 9" high, with spans up to 15'. On top of the domes the concrete is 2" thick. The result is a concrete floor with a wall board ceiling on the under side.





The upper walls above the basement have a total thickness of 12", cored, however, like the floors, with the wall board domes 5" in depth forming studs 12" thick, with air spaces between. At the corners, just below the floor, the wall is solid for a depth of 1', the roof is flat, surrounded by a ' parapet, and the roof is of the same construction as the floors.



FIGS. 12-14—(TOP TO BOTTOM) SECOND FLOOR, FIRST FLOOR, AND BASEMENT PLANS

Interior partitions are solid concrete of varying thickness; some of them only 1½". All interior walls are plastered with gypsum plaster, with sand finish. All necessary heating and plumbing pipes are concealed. This was easily accomplished by the domes in walls and floors. The mix on the entire job was 1 part Atlas cement, 2 parts sand and 4 parts trap rock up to ¾" size. An idea of floor and wall construction is given in the construction views reproduced from the photographs.

The form system used, previously described in this magazine,[2] consists of plates, ribs and liners, the plates being released usually a day after the concrete has been poured and the supporting ribs and liners coming down at a later time. Inasmuch as the ribs form part of the surface of the concrete, the lines of these ribs remain visible. All that was done to the exterior was to point up here and there, rub down a few slight projections and uneven spots, and cover with a white cement wash.

[2]CONCRETE, Jan., 1919 (described elsewhere in this book).

Block and Stucco Bungalows at Riverside, Ill.[1]

Three good-looking bungalows of stucco-covered concrete block are illustrated on page 26. They are representative of fifteen such dwellings erected in the last building season at Riverside, Ill., by E. Conrad Carlson, Cicero, Ill.

On this page are shown progress views of their construction, and on the following page are some of the more important structural details.

In the last few years Mr. Carlson has built more than two hundred homes, a large part of them of concrete. More recently he has standardized on concrete block and stucco, and the materials giving the best house for the least money.

According to Mr. Carlson's figures these bungalows cost about the same as stucco on hollow clay tile, but he prefers them as being much more substantial. He finds that the cost is about ten per cent less than common brick with face brick front, and about twenty per cent cheaper than common brick with face brick on three sides. In view of the fact that these dwellings are on fairly wide lots and spaced well apart, appearance would dictate the use of face brick on three sides, and as the appearance of the concrete block and stucco houses compare favorably in every way with similar dwellings of face brick, it is with that construction that comparison should be made.

Mr. Carlson prepares most of the plans himself, and no two are alike unless the prospective owners—most of the dwellings being built on order—insist on repetition. While some people tell him that he could make more money building apartments and two-flat dwellings, he prefers the single homes—likes that way of solving the housing problem.

The block for all this work are made by Gus Grant, Riverside, and he also does the mason work. He finds that stucco surfaces greatly simplify not only the block manufacturing problem, but the matter also of erecting the walls. Instead

FIGS. 1-3—PROGRESS VIEWS IN THE CONSTRUCTION OF CONCRETE BLOCK BUNGALOWS AT RIVERSIDE, ILL.

[1]From CONCRETE, January, 1920, p. 47.

of a lot of odd-size block and special pieces, Mr. Grant has to provide only two sizes, besides lintels and water tables. Half block and jamb block are made on the job by cutting the regular block.

Ten-inch block are used for foundation, up to the first floor joists, and eight-inch block for the upper walls. There is a water table course at the ground line that projects two inches. A belt course, cast in place, at the window sill lines, obviates the necessity for separate sills, and gives attractive variety to the wall lines. Walls are furred, lathed and plastered inside—in no case is plaster applied direct on the inside of the block. The stucco is three-coat work, the first two are each about 3/8″ thick, made of a proportion of one part cement, three of sand, with 1/10 part by volume of hydrated lime. Before applying the first coat, the block wall is thoroughly wetted and the first two coats are wetted before the succeeding stucco is applied. The first two coats are roughened before hardening. One day elapses between the first two coats, but the final coat, dashed on, using a ready mixed stucco, Stonekote, in tints, is applied a week later.

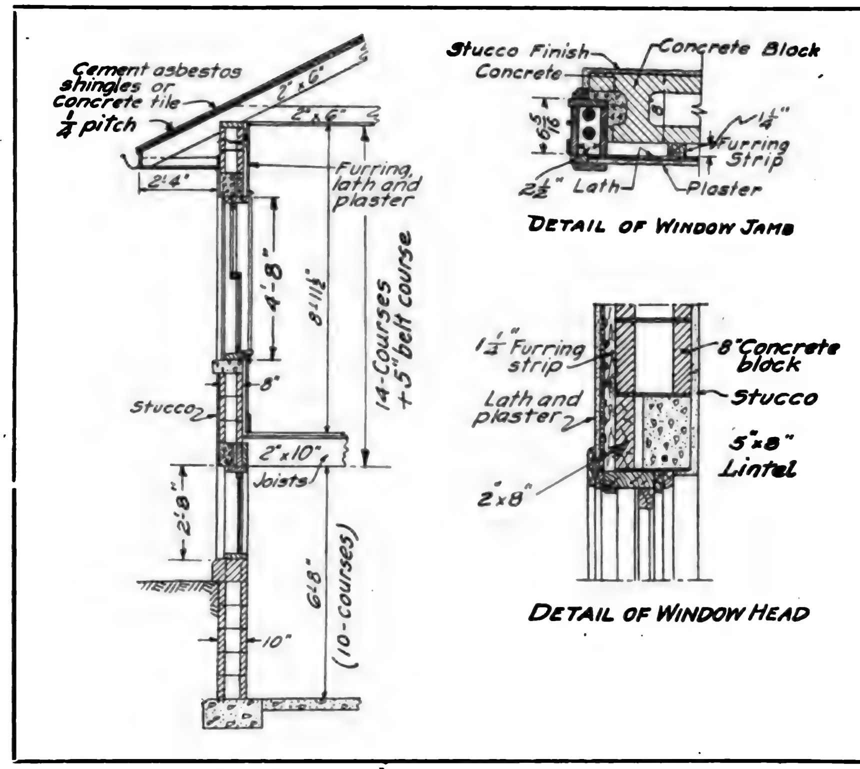
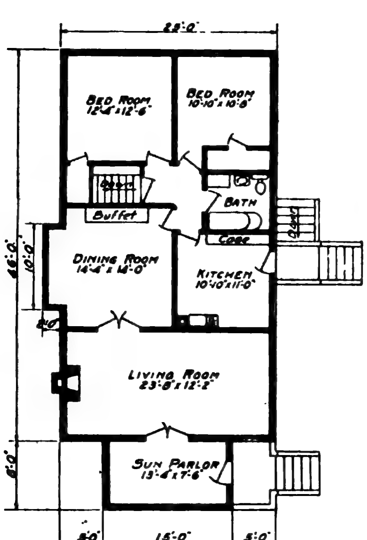
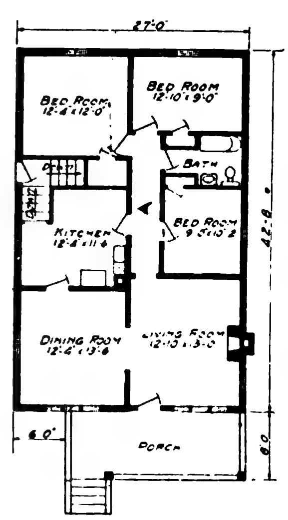
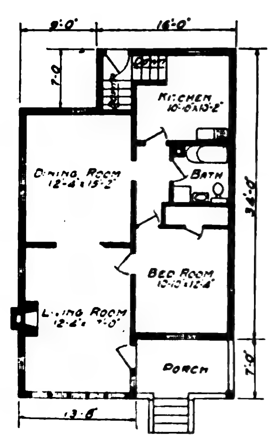


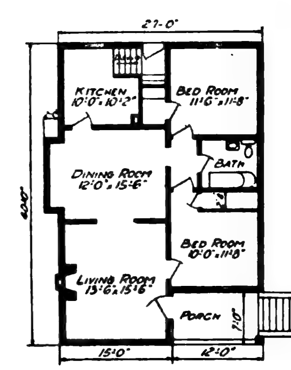
Fig. 4—Details of Construction on Riverside Bungalows

The bungalows are well finished throughout with oak floors and trim, with tile floors in bath rooms and kitchens, fireplaces, good plumbing, concrete porches and roofs of concrete tile or asbestos cement shingles.









Mr. Carlson's House Plans Are Varied to Suit Each Purchaser

FIG. 1—GROUP OF CONCRETE BLOCK HOUSES, HALIFAX

Re-Housing in Halifax With Concrete Block[1]

ROSS AND MACDONALD, ARCHITECTS

The reconstruction of the devastated areas of Halifax is of special interest in the field of concrete construction, because it involves the most pretentious utilization of concrete blocks that has ever been undertaken. While many cheaper houses were erected of frame construction, it was decided by the Halifax Relief Commission that the most economical and most satisfactory results could be obtained in a better type of dwellings by using concrete block.

The group of row type houses constructed with this material includes 326 separate dwellings, and in addition to this several hundred separate dwellings which come in that part of the Relief Commission's work designated as "individual housing," involving a much larger area and more scattered undertakings.

The type of block selected for this work is known in the concrete products field as Hydro-stone. These block were used above grade, with monolithic foundation walls.

OUTLINE OF HOUSING PROGRAM

The Halifax re-housing problem differed radically from that presented by the usual industrial town or housing development, in that well developed streets had existed in this area before the explosion, and the water and drainage service in the streets was still intact and must, if possible, be taken advantage of. The former layout, however, had been most unsatisfactory, in that the streets had been arranged on a hillside in rectangular blocks, so that the cross streets mounted straight up the hill at a steep grade, with main thoroughfares only at the top and bottom of the slope, with no convenient means of communication between them. It was finally decided to retain as many of the old streets as possible, preserving the existing water and service lines, and to introduce two new diagonal thoroughfares, so as to give communication at an easy grade between the top and bottom of the slope, that is, between Gottingen and Barrington streets.

It was also decided to purchase a tract of land known as Hennessey's Field, bounded by North Creighton, West Young, Robie and Kane streets, and to build thereon some 60 detached houses, entirely of wood construction, but with interior finish of plaster, so that these could be made ready for occupancy at the earliest possible date.

In addition to these two developments or groups of houses, individual homes were started just as soon as the owners could be interviewed, and a type of house agreed upon, and these detached houses began to spring up all over that portion of the devastated area west of Gottingen street.

The work of re-housing has therefore divided itself into three parts, which will be called "The Group Development," "The Hennessey Field Development" and "Individual Housing," each of which will be described in turn, with a detailed description of block and trim stone manufacturing methods.

As the purpose of the group development was to give shelter to as many families as possible while their own permanent houses were being built, and afterward to provide dwellings which might be rented by those families who were tenants in the devastated area, it was decided to build dwellings of from four to six rooms each, with bathroom, electric light, etc., and to arrange these dwellings in short rows on each side of a series of large grass plots, which would serve as playgrounds for the children. Between each pair of grass plots, so that the rear porches of two rows of houses would be on opposite sides, service lanes were arranged.

After considering carefully the various materials available for use for the exterior of the houses, it was found that the cheapest would be wood, either clapboards or shingles; the next cheapest some form of precast concrete block, the next stucco, and the most expensive brick, or concrete formed in place. As a fireproof material was desired, it was decided to make use of a special concrete block called Hydro-stone, and to manufacture this block at a plant built for the purpose at South Eastern Passage, Nova Scotia, where a plentiful supply of sand and gravel was available. It was also decided to roof the buildings with slate, but to construct the interior floors and partitions of wood finished with plaster.

[1]From an article in CONCRETE, Feb., 1919, p. 45.

FIG. 2—SIDE-REAR VIEWS OF TWO BLOCK HOUSES AT HALIFAX

Plans—The buildings containing four dwellings each are of six types.

For purposes of comparative cost, the local material and labor market were carefully studied and estimates prepared (using varying types of construction) of a detached two-flat house, having four rooms and bath on each floor, with outside dimensions 28′ x 29′ and two full stories in height. Each type of construction investigated is indicated in the following table, in order of cost, beginning with the lowest. Since all interior finish, such as lath and plaster, paint, finished woodwork, floors, etc., is applicable to each type, and therefore practically unchanged as regards cost, consideration for comparative purposes has been limited to the several forms of wall construction only.

Considering the lowest priced construction as 100%, the comparative costs were determined as in Table 1.

It was found, from actual comparison of cost after several months of operation of the hydro-stone block plant, that the difference in cost between frame building with shingle and hydro-stone was 5%, instead of 3% as estimated. The increased cost was largely due to transportation costs from the plant to the works and the reduction in the estimated output of the plant, due to labor difficulties.

In each of these plans the middle apartments show five rooms and a bathroom, and the end apartment six rooms and a bathroom. Where only two rooms are shown on the first floor, as in the middle apartments, a kitchenette has been provided by partly screening off a portion of the kitchen, and placing in this alcove the service fixtures, such as range, sink, and water heater. This leaves a large part of the kitchen quite free for use as a dining room.

The six types of buildings containing four dwellings each differ from each other as to exterior treatment also, Type T. 4, 1 being entirely of concrete block with hipped roofs; T. 4, 2 of concrete block in the first story and of stucco and half timber treatment in the second story, and with gambrel roofs; T. 4, 3 is entirely of concrete block, with simple pitch roofs and concrete block gables; T. 4, 4 has stucco and half timber treatment in the second story, but differs from T. 4, 2 as to the design of the roofs. T. 4, 5 is treated in the second story in stucco alone, with pitch roof and gables of stucco, but without the half-timber work. T. 4, 6 also has stucco treatment in the second story, but differs from T. 4, 5 as to roof treatment.

In this way it was found possible to have, with only three variations of plan, twenty-four apartments, each differing one from the others sufficiently to give it a certain individuality.

The entire development of 326 dwellings contains four buildings of Type T. 4, 1; four of Type T. 4, 2; ten of Type T. 4, 3; eight of Type T. 4, 4; five of Type T. 4, 5, and six of Type T. 4, 6, or a total of 37 buildings, con-

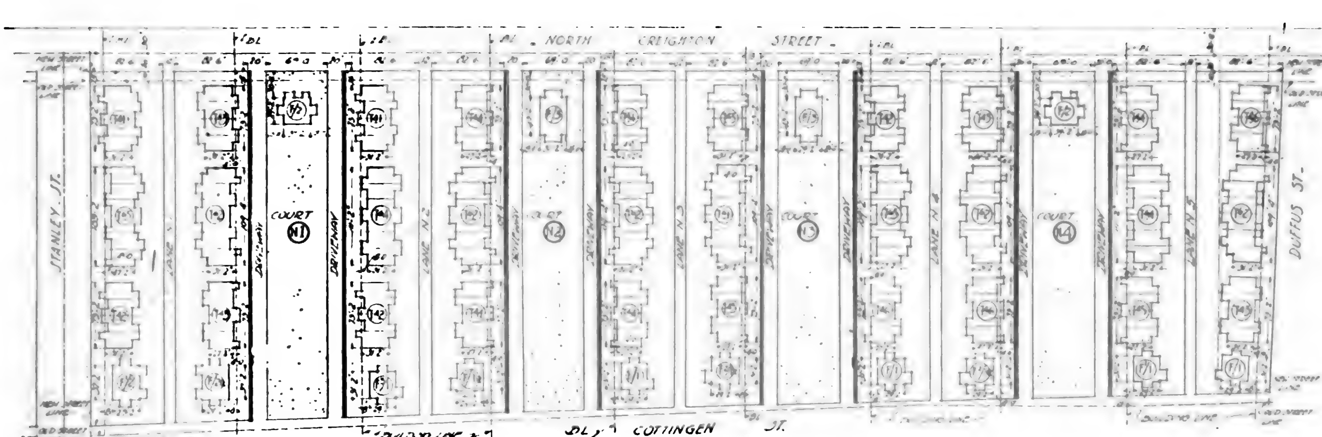


FIG. 3—LAYOUT OF A PORTION OF THE GROUP DEVELOPMENT IN THE RECONSTRUCTION OF HALIFAX

Fig. 4—A Court of Concrete Block Houses at Halifax

taining four dwellings each. The remainder of the development is composed of buildings containing six dwellings each, and some buildings containing two dwellings each.

The buildings containing six dwellings each are of five different types; these differ from each other in the same way as the T. 4 types, both as to arrangement of plan and as to treatment of elevation. There are in all, in the group development, 19 of these buildings, containing 114 dwellings.

The first floor plans of all these buildings are much the same, the four middle apartments being of the five-room type, with living room, kitchen and kitchenette downstairs, and three bedrooms and bathroom upstairs, and the two end apartments are of the six-room type, with living room, dining room, kitchen and pantry on the first floor and three bedrooms and bathroom on the second floor.

In some cases the plans of these dwellings are reversed in order to vary the treatment of the elevation.

The elevations of these buildings, each of which contains six dwellings, are varied in each case, but all are built of concrete block, in some cases from the grade line to the eaves, including gable ends, and in other cases up to the second floor line only, the houses being built with stucco and half-timber work above this level. The stucco, however, is in such cases applied to the surface of rough Hydro-stone concrete blocks, of which the walls are built. Where the concrete blocks are exposed they are faced to give a mottled granite effect. The types of elevation in general follow the same lines as those described above for the houses of the T. 4 type, having in some cases hipped roofs, in other cases gambrel roofs, and sometimes double pitched roofs, with gables treated in block or stucco or half-timber work, and with wood-covered porches at both front and rear entrances. The roofs in each case are of slate.

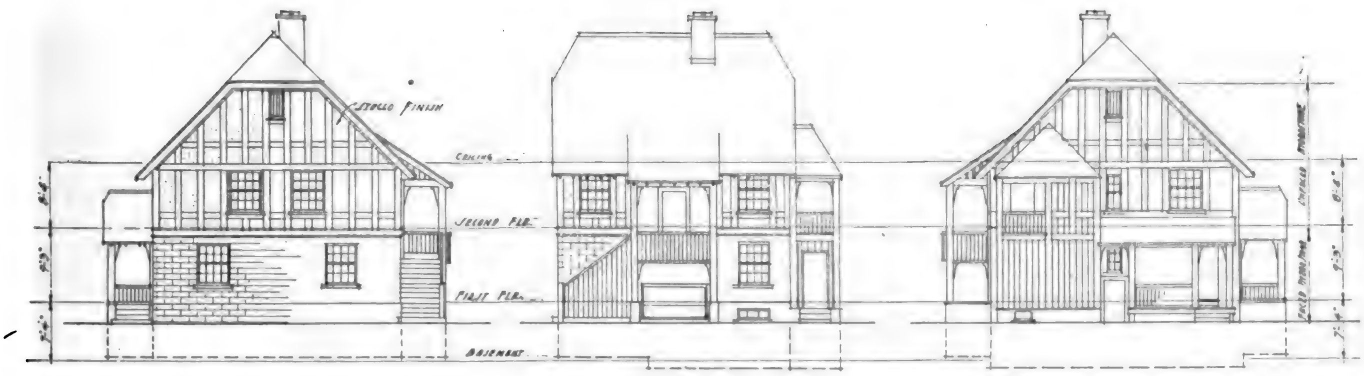
Scattered throughout the "group development" there are thirty-two buildings, each containing two self-contained apartments, one on the first floor and one on the second floor, each with its own separate entrance on opposite sides of the building. These buildings are known as "F" types, and there are three different arrangements as to plan and elevation.

In Type F. 1 each flat contains living room, kitchen,

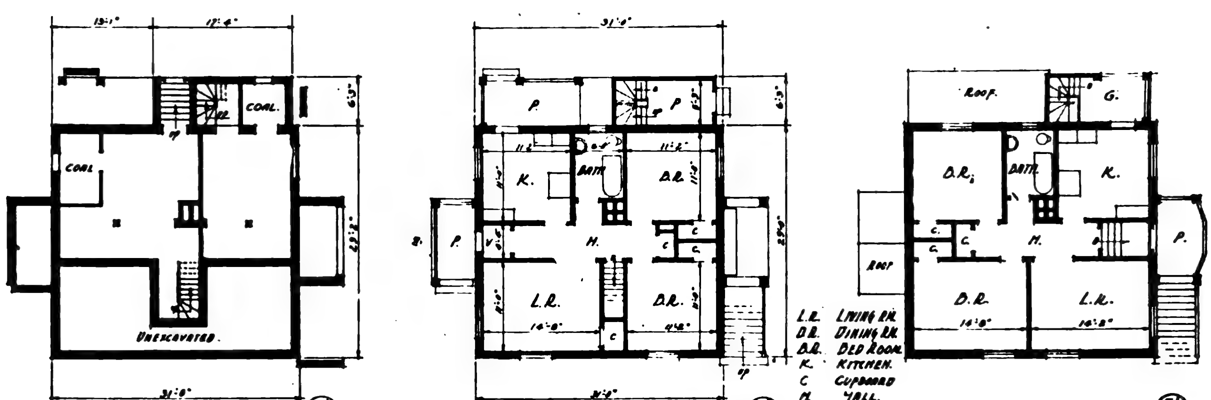
Fig. 5—Square Type Concrete Block House—Halifax

Table 1. Estimated Costs of the Various Types of Construction

Type	Description	Value
1 Frame sheathing, with shingle and stain	Exterior walls, 2" x 4" spruce studs, sheathed on the outside with ⅞" tongued and grooved spruce, covered with one layer of 1-ply prepared roofing, and shingled with No. 1 clear shingles, dipped and stained with creosote stain	100%
2. Frame sheathing, with dropsiding, painted	Construction similar to No. 1, replacing shingles with spruce dropsiding, painted three coats of lead and oil paint	101.2%
3. Concrete pre-cast block	Exterior walls constructed of two lug concrete blocks set in cement mortar	103%
4. Frame sheathing, Bishopric board and cement stucco	Exterior walls, 2" x 4" spruce studs, sheathed on outside with ⅞" tongued and grooved spruce Bishopric strucco board, and finished with cement stucco	104.2%
5. Frame sheathing, metal furring, lath and cement stucco	Exterior walls, 2" x 4" spruce studs, sheathed on outside with ⅞" tongued and grooved spruce, covered with one layer of 1-ply roofing, furred with 1" x 2" furring, finished with metal lath and cement stucco	105.6%
6. Brick veneer	Exterior walls, 2" x 4" spruce studs, sheathed with ⅞" tongued and grooved spruce sheathing, covered with one layer of 1-ply roofing veneered with brick	106.9%
7. Solid brick	Exterior walls of brick, two brick in thickness	108.8%
8. Monolithic concrete	Exterior wall poured concrete, 8" thick, rubbed to an even surface on outside face	116%



FRONT ELEVATION (F/1) SIDE ELEVATION (F/1) REAR ELEVATION (F/1)



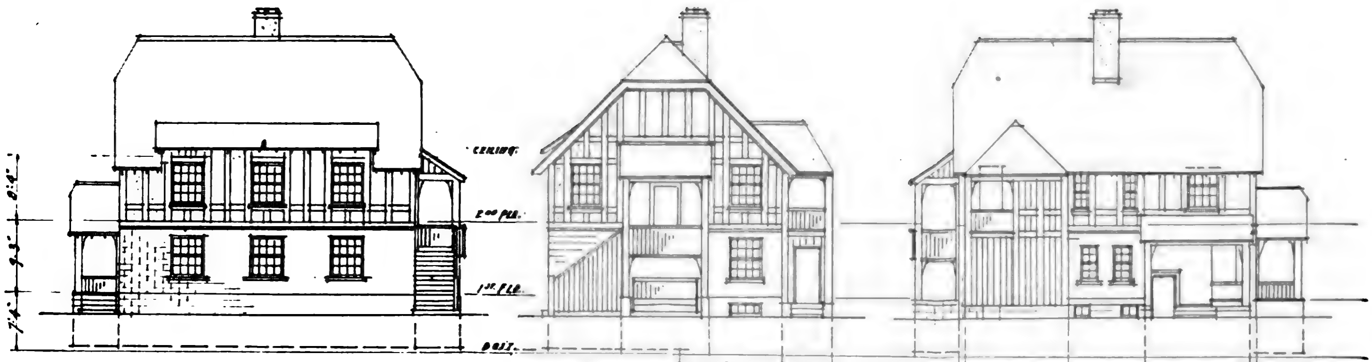
BASEMENT PLAN. (F/1) FIRST FLOOR PLAN (F/1) SECOND FLOOR PLAN (F/1)

SIDE ELEVATION. (F/1) SECTION. (F/1)

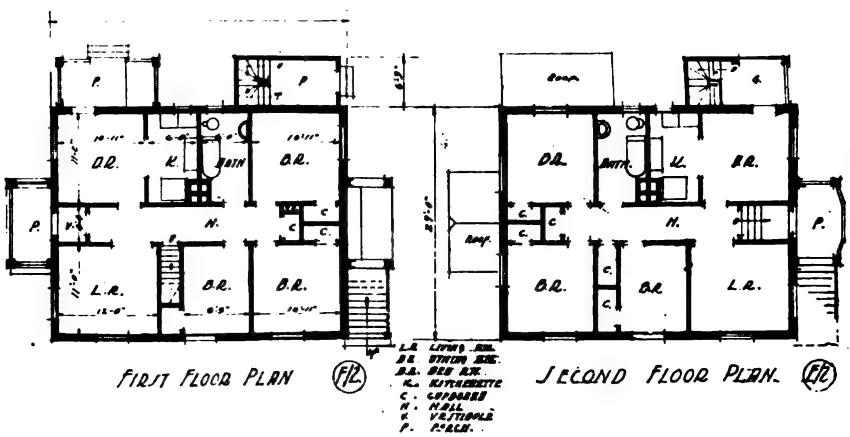
Plans and Elevations of Some "F" Type Houses of Two Apartments Each

1" equals 24'

FRONT ELEVATION (F/1) SIDE ELEVATION (F/1) REAR ELEVATION (F/1)

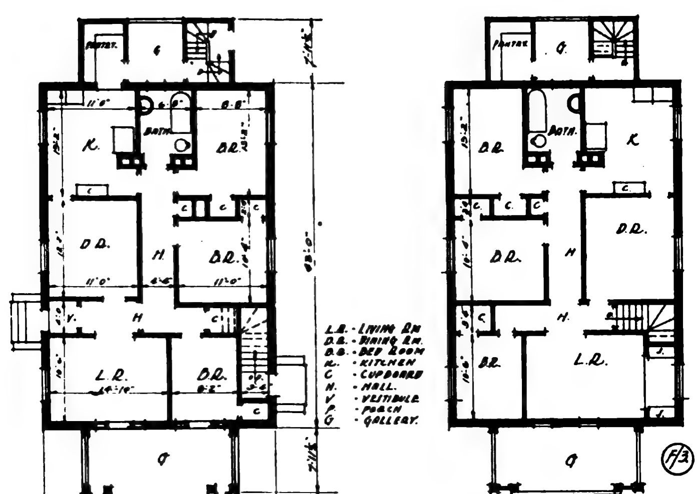


FRONT ELEVATION · F/2 JIDE ELEVATION F/2 REAR ELEVATION · F/2



FIRST FLOOR PLAN F/2 JECOND FLOOR PLAN. F/2

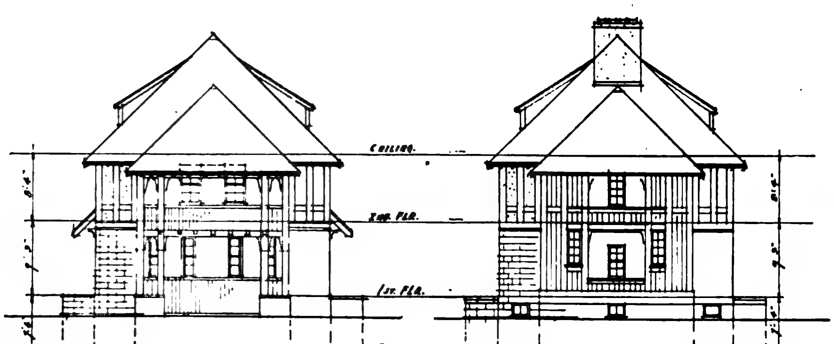
JIDE ELEVATION · F/3



FIRST FLOOR PLAN F/3 JECOND FLOOR PLAN. F/3

Other "F" Type Houses for Halifax

1" equals 24'

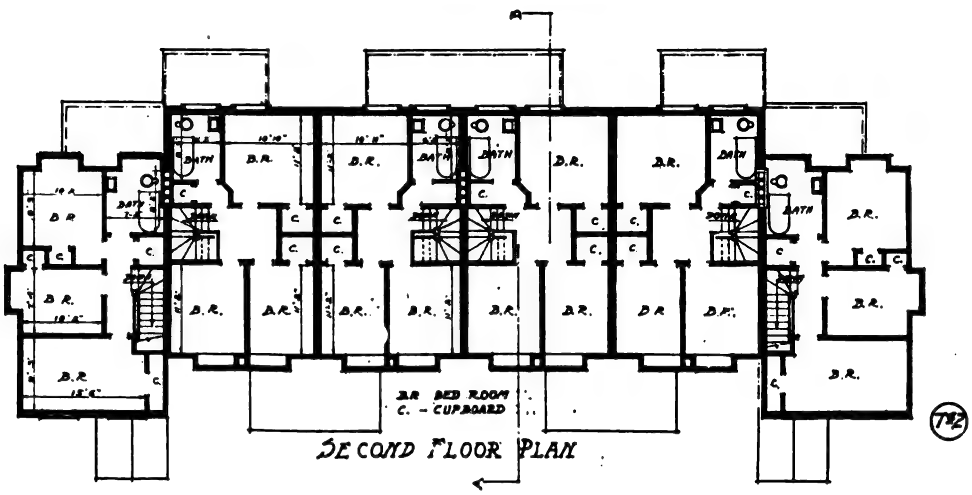


FRONT ELEVATION. F/3 REAR ELEVATION F/3

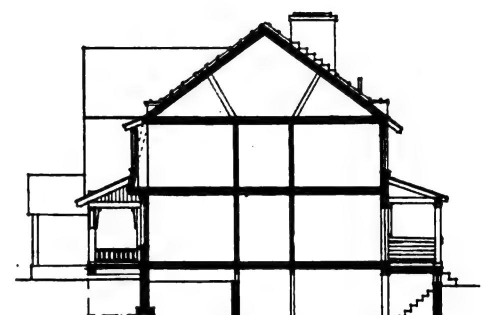
"T62" Type House Shown in Plan, Elevation and Section

1" equals 24'

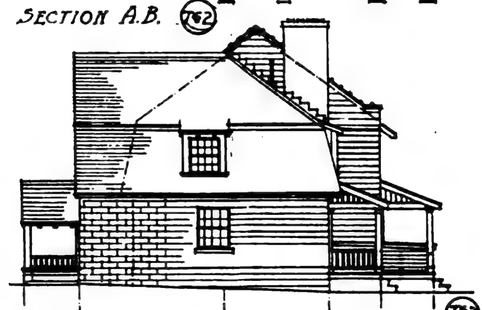
FRONT ELEVATION



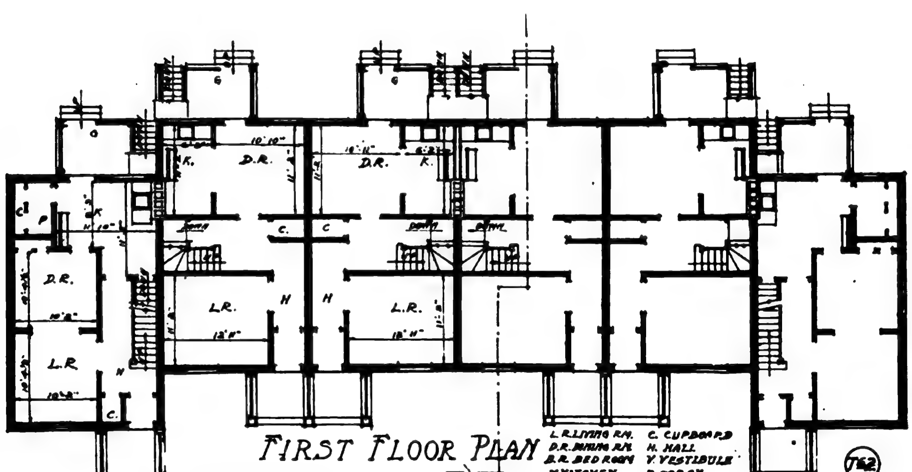
SECOND FLOOR PLAN



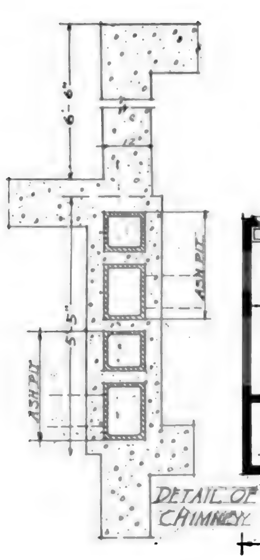
SECTION A.B.



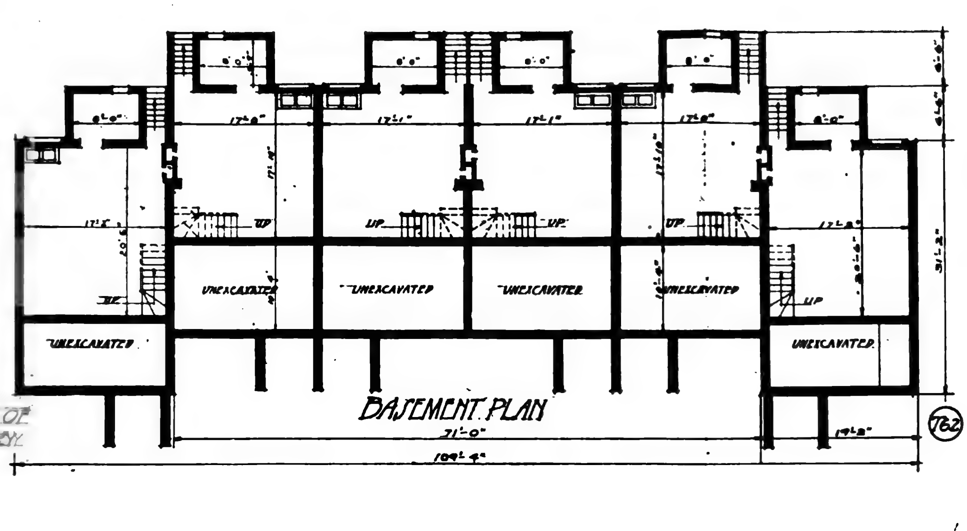
SIDE ELEVATION



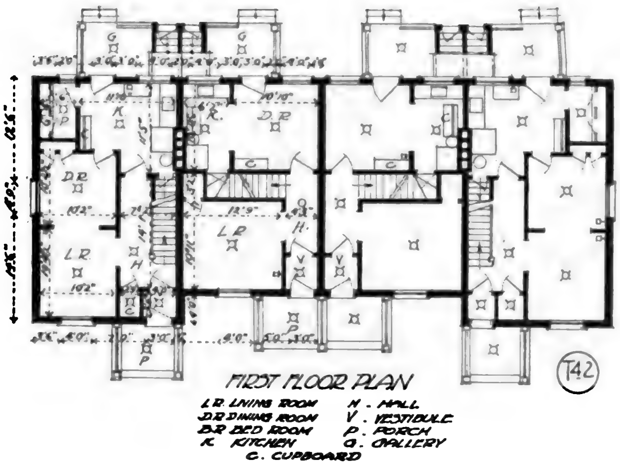
FIRST FLOOR PLAN

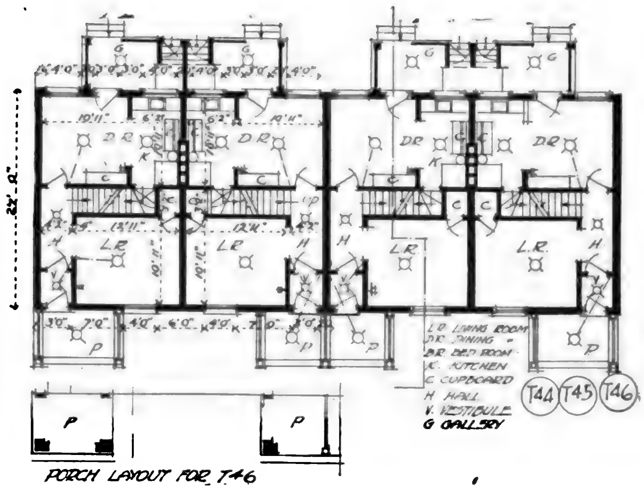


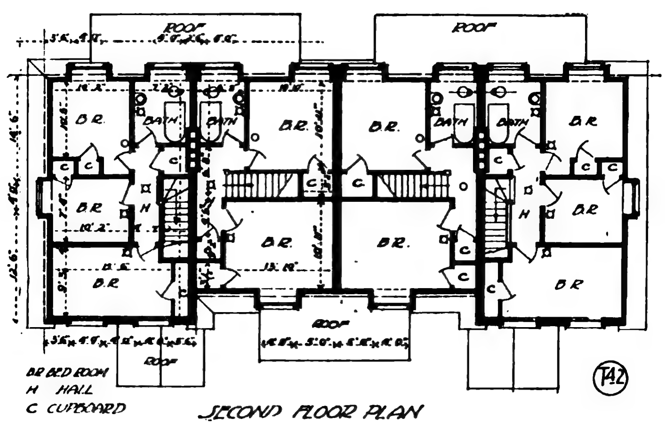
DETAIL OF CHIMNEY

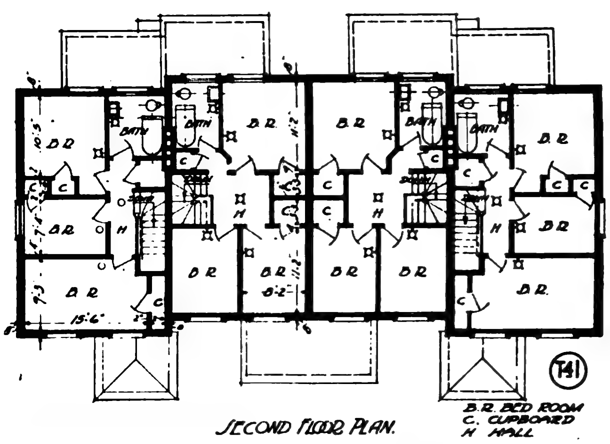


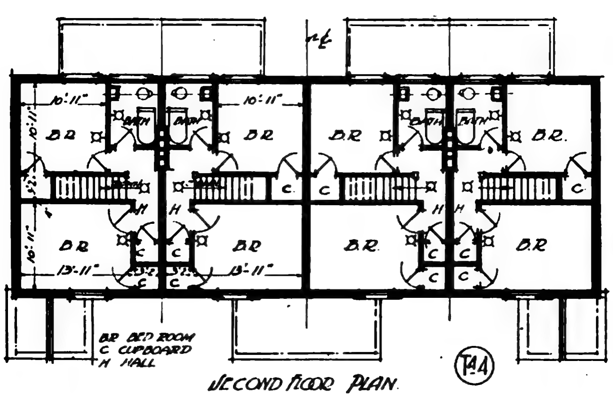
BASEMENT PLAN

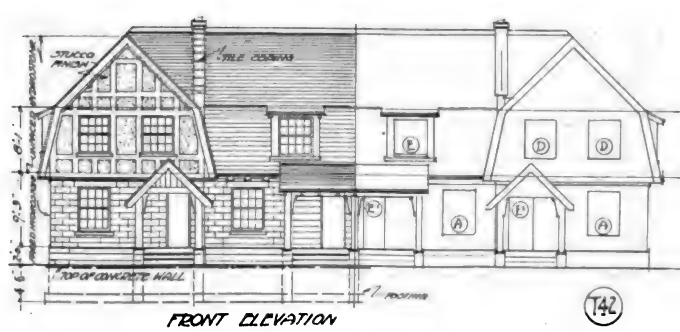


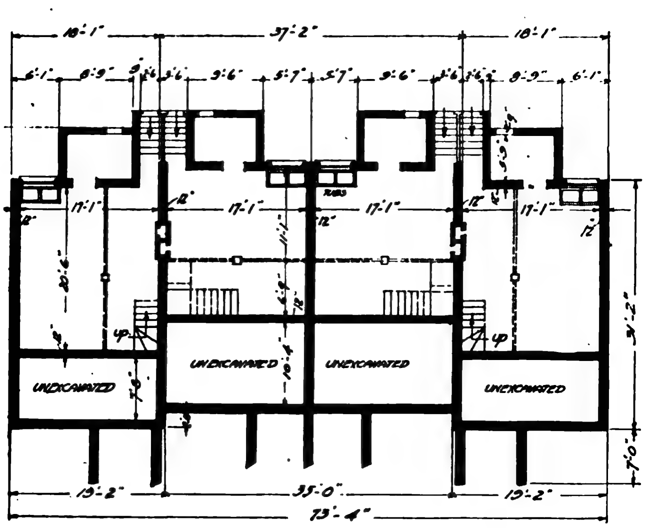


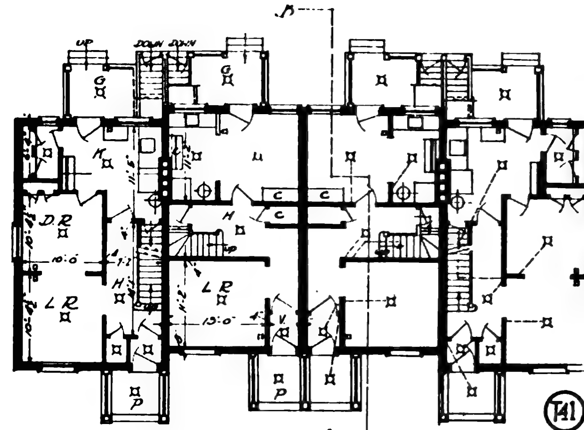












Plans of the "T4" Houses for Halifax—1" Equals 24'

FIG. 6—A ROW OF CONCRETE BLOCK HOUSES, FROM A SKETCH BY THE ARCHITECT

bathroom and two bedrooms, but no diningroom. Each bedroom is 11′ square, the living room 11′ x 14′ 8″, and the kitchen 11′ x 11′, with a bathroom 6′ x 8′. Closets are provided for each bedroom and a closet in the living room, together with a linen closet opening from the hall. The arrangement of the second floor flat is practically the same, the bathroom being directly over the one below.

The plans of the other F types are practically the same as that described above, being in some cases reversed; the elevations, however, vary considerably, being of concrete block, stucco and half-timber work, with various types of slate roofs.

Type F. 1 is of faced block up to the second floor level, with half-timber and stucco above and with a simple double pitched roof. Type F. 2 is of concrete block from the grade level to the eaves, with a hipped roof and wooden cornice. Type F. 1/1 is also of Hydro-stone from the grade level to the roof, but has a pitched roof so as to show gable walls of concrete block capped with coping of the same material. Type F. 3 is similar in elevation to Type F. 1/1.

The entrance porches, which are in every case roofed over and treated with wood posts and cornices, add interest to these elevations.

HENNESSEY FIELD DEVELOPMENT

The tract of land purchased by the Relief Commission for the purpose of erecting this group of 70 houses in the Hennessey Field Development is a trapezoid in shape, bounded on the east and west by Robie and North Creighton streets, respectively; two thoroughfares running north and south and bisected by Agricola street, another parallel thoroughfare.

On this property and fronting on these streets are grouped 47 houses of wood construction, with shingled exterior walls and roofs varied as to plan and treatment of elevation so as to produce six different types.

INDIVIDUAL HOUSING

In addition to the "Group" and "Henessey Field" developments, nearly 100 houses have been built, scattered throughout the area immediately west of North Creighton street and east of Gottingen street, on lots owned by individuals and intended to replace houses formerly occupied by these individuals. Many of these houses are of the types described above in connection with the "Hennessey Field Development," but some are of other types. Some of these houses are built with exterior walls of wood and others have exterior walls of Hydro-stone with slate roofs.

Owing to the war conditions which made it very difficult to obtain either labor or materials as required, the work has not progressed as rapidly as would otherwise have been possible.

HYDRO-STONE CONSTRUCTION

At the site of the "group development," where 88 buildings, containing 326 separate dwellings, constituting the first development, are under construction, concrete foundation walls have been put in place by the use of wooden forms, which are standardized and used many times. The plumbing under the basement floor is first installed complete, then the basement floor and footings are put in place and finished, and after this the forms for the foundation walls are set in place and these walls poured. Gravel and crushed stone carefully mixed so as to produce a strong, dense concrete, are used, together with portland cement, these materials being mixed in Jaeger mixers, with special spouting outfits, which are erected for each group of foundations.

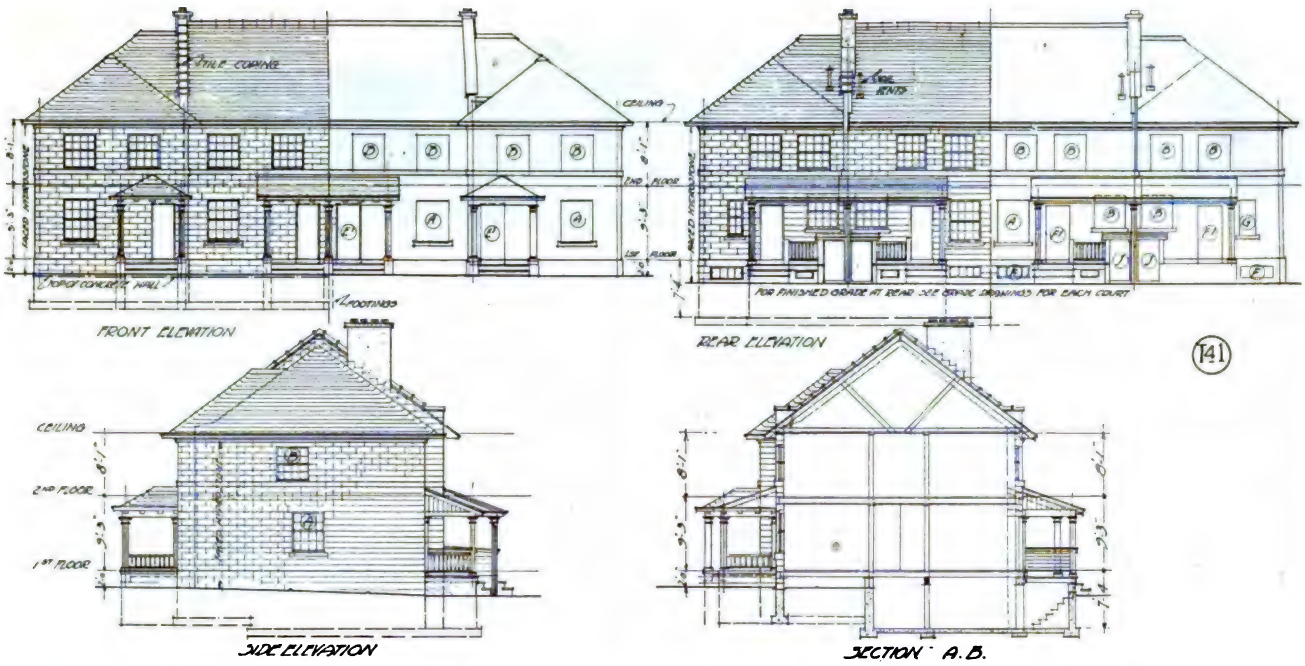
The contractors for this work have worked out many ingenious devices for erecting and removing the forms with as little labor and as little injury to the forms as possible, and excellent results have been obtained.

The concrete foundation walls are extended just above the grade line and from this level up to the level of the first floor hollow walls are constructed of Hydro-stone, consisting of an outer and an inner wall, a space being left between the end of the webs so as to form a continuous horizontal air chamber, through which moisture cannot pass. This construction is made possible by the peculiar T shape of the blocks, which allows them to be alternated on each side of the wall. The blocks are laid up with quarter inch joints, which are pointed up as near the color of the blocks themselves, as possible, and the wall closely resembles one built of finely tooled granite.

The fire-proof partitions which separate the four or six dwellings forming each block of apartments from one another are constructed in the same way from the foundation walls to the roof; the blocks are not faced, but are covered with plaster.

The exterior walls above the first floor level are built of a single thickness of blocks, having two lugs instead of the one lug of the T shape block. The stems or lugs of these blocks project into the building and form studs, to which wood furring strips are fastened, and Bishopric board and plaster are applied directly, thus leaving a series of air spaces in the wall behind the plaster. The back of the blocks is thoroughly covered with a black, tacky, waterproof paint, similar to that used for backing up cut stone, in order that there may be no chance of any moisture finding its way through joints; the block itself being so dense as to preclude dampness.

On account of the large size of the blocks, 9″ x 24″, they are laid up very quickly, and remarkable progress has been made since this work was started, a small number of masons being able to handle the output of the plant as fast as it can be delivered to the buildings.



T41

T45

Fig. 1—A Concrete Block Hamlet in Dorset, Eng.

It consists not only of cottages, but numerous farm buildings, such as silos, granaries and barns. These have been erected during the last five years and form part of a scheme designed on the lines of a model garden village. Halsey Ricardo designed the farm and dairy buildings, and MacDonald Gill, who acted as resident architect of the project, is responsible for the design and general layout of the cottages.

Fig. 1—House in Yonkers, Built of Concrete Stone, by James Hooper; Harold V. Walsh, Architect

Fig. 2—Details of Porch, Balcony and Entrance, Involving Precast and Poured-in-Place Work in Glue, Plaster and Wood Molds

House of Concrete Stone at Yonkers[1]

By Harold V. Walsh
Architect, Yonkers, N. Y.

The problem of the concrete block house has been solved in an unusual experimental building recently completed in the city of Yonkers. The prejudice which most architects have against the ordinary concrete block was taken at full value and an attempt was made to overcome it. This prejudice lies in the fact that most concrete block houses are extremely ugly, due to the inherent dead appearance of the material of which the blocks are made, and secondly that the artistic possibilities are extremely limited. Another common dislike for the concrete block house lies in the belief, due to early developments, that they are extremely damp. If the concrete block could be made cheap, full of sparkling, artistic texture, very elastic in artistic development, and damp-proof as well as durable, it seemed that the prejudice held by most architects against this type of dwelling might be broken down. With this end in view, the house shown in the illustrations was built. It is essentially a show house, and an experimental problem which has been an absolute success in solving the difficulties already stated.

By the closest co-operation between builder and architect, a scheme was evolved for building this house. As the builder, James Hooper, of Yonkers, has experimented for many years in developing the artistic possibilities of concrete block, and secured many interesting patents on his processes, he was quite ready to use his inventiveness in solving this particular house problem.

The block which he decided to use was of a shape and mixture which he had been experimenting on in a small way for a number of years. Although this block is of an excellent type, yet he has since developed another which he considers better. In two of the illustrations (Figs. 13 and 15) it will be seen that the block used has a central round hollow space between each course. At the corners these hollow spaces miter and there are vertical openings with vent holes in the bottom of the wall.

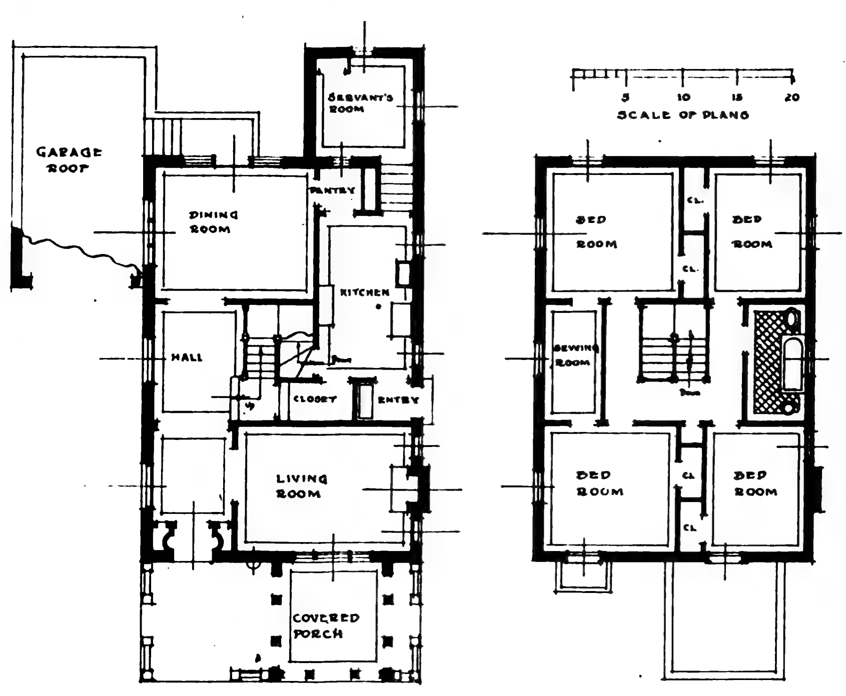


Fig. 3—Floor Plans, Yonkers Concrete Stone House

[1]Concrete, January, 1918.

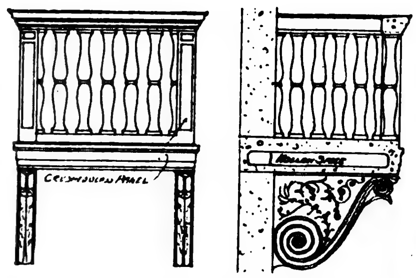


Fig. 8 (Above)—Front Elevation and Section of Concrete Balcony

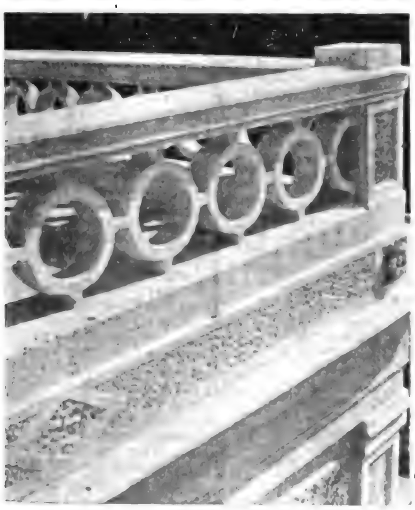


Fig. 4 (Left Top)—Detail of Front, Showing Balcony Brackets, Baluster and Circular Pierced Porch Rail

Fig. 5 (Left Bottom)—Porch Rail Cast Around Sand Patties or Cores

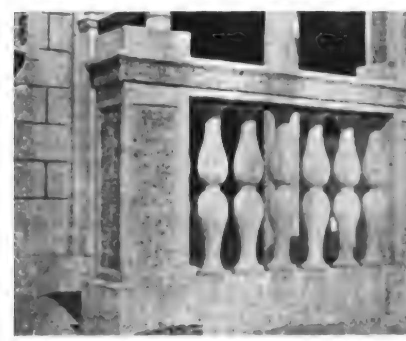


Fig. 6 (Right Top)—Detail of Concrete Balcony

Fig. 7 (Right Bottom) — Showing Molded Balusters and Tooled Posts and Rail

The important feature of this block lies in its surface. Although the body of the block is a cheap, poured product, the outer surface to a depth of 1″ is composed of white cement, pure crystaline aggregate, such as marble or granite, and an integral water-proofing compound. When this block is taken out of the mold and set up in the wall it has the appearance of a bad piece of terra-cotta work. However, when it is finally set, a compressed air tooling machine is run over the entire wall, as though it were being cleaned down. This tooling brings out the glisten and brilliancy of the aggregate. In the illustration it will be noticed that the block for the main body of the wall are shaped to represent ashlar stone work. The color of the surface is cream, with spotted white marble aggregate and black joints. The corner blocks are rusticated and are pure white. These were cut with the chisel while green, and retain all of the sparkle of the fresh cut aggregate. To the casual eye both blocks look like expensive cut stone ashlar. The actual depth of this beauty, however, is only an inch.

In planning this block the molds were so made that they would be an improvement on the poorly shaped concrete blocks that are commonly seen. These blocks are 10″ high by 24″ long. They are 10″ thick in the cellar walls and 8″ thick for other stories. The wall made with them is damp-proof, for the 1″ of water-proofed material on the surface permits no penetration of moisture. Although the whole of this house was not plastered directly upon the inside of the block without using furring strips, yet a part was left for experimental purposes. The entire side wall of the kitchen, which is on the east side of the house, was left unfurred and the plaster applied directly to the inside surface. The house has been through one entire winter, and so far not a sign of a leak or penetration of moisture is visible. In building another house of this character it would cut down much of the expense to eliminate the furring.

To show the artistic possibilities of the concrete block house, it was necessary to develop architectural features of the same material in numerous forms. Although the house is not large, a great many special architectural features were added to show the possibilities of concrete stone.

The porch is especially ornate. To solve this by the ordinary methods of concrete molding would have been too expensive, where it was desired to bring this ornamental work within the reach of the ordinary home builder. The design would have been financially out of the question if it had to be cut in stone.

The main body of the porch was poured into rough wooden molds as usual; that is, the corner piers and rough open arches. When the forms were removed, while the concrete was still green, the tooling machine was turned on it to scratch it up. As the concrete was very soft, this required very little time. When the rough body of the porch was complete a plaster mold was set up into position for the cornice. This had been made in the shop on the floor by running it with a template of the cornice moldings. Shellaced and greased, it was set and ready for pouring. The rough body of the porch, where the cornice was to go, was soaked with water and

FIGS. 9 AND 10 (AT LEFT)—WINDOW WITH DECORATED PANEL SURFACE OF BROKEN GLASS

FIGS. 11 AND 12—FOUNTAIN AND DECORATED WALL PANEL, SHOWING USE OF BROKEN GLASS AND COLORED BEAD AGGREGATE

the new surface coat poured in between the mold and rough body. This was allowed to set well before the molds were removed. When they finally were removed, the surface of the molded cornice had become part of the solid mass of the porch. It was then rubbed in its more delicate portions with carborundum and tooled with the tooling machine in the larger plain surfaces.

The corner pilasters and the architrave moldings over the little arches were cast on the floor in molds, reinforced, lifted to position, thoroughly wet and fastened to the rough structure with cement mortar. The columns are from plaster molds made from a turned wood model. They were reinforced and set into position and tooled.

Spandrel panels were then molded about 1″ thick, reinforced, and the surface finished with broken colored glass so incorporated into the cement that the surface was entirely level, the glass particles giving the appearance of mosaic work. These panels were set up into place on the rough body of the porch with cement mortar. The appearance of these panels with the glass aggregate can only be appreciated when seen. No photographs can picture their brilliancy and sparkle and richness of color. They have none of the cheap appearance of the glass work that is sometimes seen, in which broken pieces of glass and pottery are embedded in the surface of stucco. These particles of glass are set absolutely flush with the surface.

This same glass surface was adopted for the ceiling of the porch, so that when the central light of the porch was lit it would give sparkle to the entire ceiling. Usually the cost of roof construction like this is very high, on account of the forms necessary to build in its construction. This roof, although it is beautifully panelled and rich in texture, was set up without one single form being used. Reinforced concrete beams were molded in the shop in the forms of a T upside down. As the plan of the roof is square, one of these beams was set at equal divisions on each side. Shorter lengths of similarly shaped concrete beams were set at right angles to these beams, forming square panel openings in the ceiling. The bottoms of these beams were set flush with the bottom of the others by cutting away the lower flange and permitting the vertical web to rest on the flange of the large beam. With this arrangement of beams, the square openings were filled with square reinforced slabs. These slabs were finished on one surface with the same glass texture as used in the panels of the spandrels. They were set into place on beds of cement mortar put on the lower flanges of the beams. This formed the finished ceiling immediately, and a thin concrete mixture was spread over the top of the slabs to make the floor of the top of the porch.

After the roof had hardened, the balustrade was set up. A pattern was chosen for this which would show the possibility of open work. The type of baluster made would cost a nice little penny to reproduce in any cut stone. This, however, was produced at reasonable cost. Each circle and connecting link of this chain balustrade is reinforced. To have used wooden forms for this work would have been an expensive thing. A better type was adopted. Pattypan sand cores with a little cement for stiffening, were set out on a table at just the places where the holes were to be. In other words, wherever the round holes through the center rings came, and the segmental holes around the outside of them were located, these were set with sand pies of this shape molded from one standard mold and dumped out on the table. This made a series of small canals between the sand pies, which ran the same as the pattern of the balustrade. The concrete was poured into these canals,

FIG. 13—SHOWING GUTTER IN CORNICE

FIG. 14—HOUSE UNDER CONSTRUCTION

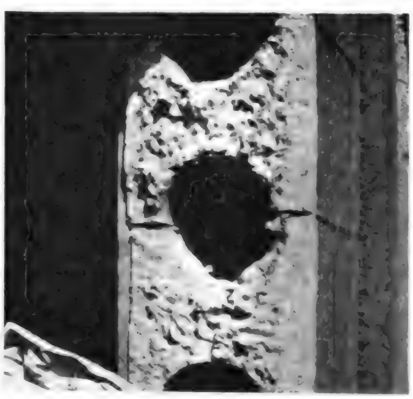


FIG. 15—CORES IN CAST BLOCK

and thus the balustrade was cast. When set, the sand cores were knocked out.

In building the ornamental balcony over the doorway, the platform was molded around the edge, using plaster molds, and the center was made hollow by means of a sand core. Everything was reinforced. The balusters, which were molded in plaster from a wood-turned model, were also reinforced. When these were removed from the molds they were washed with cement grout and rubbed with carborundum. In the case of the ornamental brackets supporting the balcony, the model was first made in clay and a double-sided mold taken of it in plaster. When removed from the mold and set into position it was tooled to bring out the sparkle of the marble aggregate. Two beautiful little glass panels were made on the corner piers of the balcony. These glass panels differed from the others described, in that they were rough cast. Pure cement was plastered over the panel surface and finely ground blue bottle glass was embedded in the surface by throwing it at the cement. The underside of the platform had a panel worked in it with the tooling machine.

All the architraves of the window were molded separately and reinforced so strongly that when they were set they were lifted and put into position as though they were wooden boards.

Ornamental features with undercut work were also added in panels and other forms. They were made in glue molds. It is noteworthy that everything has stood the test of a severe winter and not a sign of even a hair crack is visible in the entire building.

One of the interesting features near the entrance is a small wall fountain which has the molded head of a lion standing out from a background of unusual charm. The background looks as though it were composed of fossil shells of wonderful color. It is, however, made with children's colored beads set so smoothly into the surface that it produces this remarkable texture, the white cement showing through the hole in each little bead, giving the curious shell-like effect.

Another feature which is striking at the entrance is the concrete floor of the porch. This is made of gray cement, using a marble aggregate. A pattern is marked out on it by tooling certain surfaces to reveal the sparkle of the white aggregate. The result looks similar to mosaic work and is very beautiful.

The entire cornice of the building is made of the concrete stone. In the top of the cornice is a gutter, which does away with any tin-lined one. The roof is covered with red concrete shingles. These shingles were made ½" thick, 18" x 24". They were reinforced with wire mesh and set up just as a tile roof would be laid. A special ridge tile was molded. This roof was an experiment, which has proved successful. It has shown no signs of leakage, and the tile are still undamaged after a severe winter's test.

Different types of surface finish were made on many features of the building in order to supply examples of what could be done. Granite rough cast panels, marble dash, glass dash, smooth surface glass, rock faced, tooled work, etc. All this can only be seen on close inspection of the building itself. In the living room there is a large ornamental fireplace of concrete.

A special feature of the dining room is the fact that a French window leads out on to a little balcony, from which steps run up to the roof of the garage, where a pleasant sitting porch is afforded.

Corresponding to the garage, and a few flights of steps down and off of the kitchen, is the servant's bedroom.

The garage connects by a metal covered door with the cellar of the house. Its ornamental value is sufficient to add to the house rather than detract.

The garage roof, as well as the roof over the servant's bedroom extension, was made without using any centering. This, of course, went far towards cutting down cost.

This unusual house, with all the experimenting tried on it, cost, *inclusive* of plumbing, heating and electric work, painting and fixtures, not more than nine thousand dollars. If the excessive show work of ornamental character which was put on it for a purpose, were cut down to a more sober scheme, the building could be reproduced for much less than the above figure.

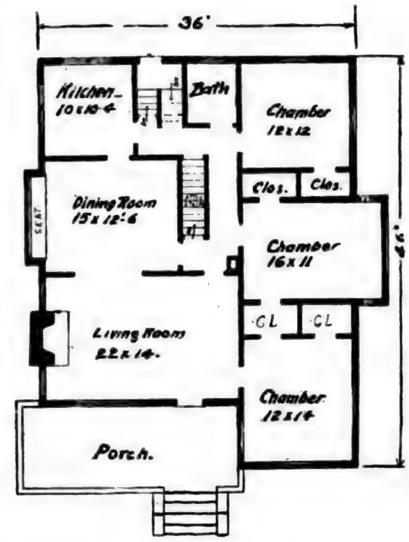


Fig. 1—Bungalow of Concrete Brick by Merrill Moore, at Creston, Iowa
Fig. 2—(At Right) Floor Plan of Merrill Moore Bungalow

Double Wall Bungalow of Concrete Brick

Concrete brick dwellings have not been common, yet there is no reason why concrete brick should not be made attractive in color and texture and in such a way as to give a good, substantial building unit at low cost. The accompanying illustrations show a bungalow built by Merrill Moore from his own design, using brick which he himself manufactured. The bungalow itself is shown in Fig. 1, the plan in Fig. 2, showing the dimensions 46′ x 36′. Footings are 8″ x 16″, reinforced with 5/8″ twisted steel bars. Basement walls to grade line are built of poured concrete block, having horizontal cores and reinforced with 5/8″ twisted bars. The walls of the house are 9″ thick, made of brick, the brick being laid with a 1¼″ air space between the outer and the inner course, which are tied with metal ties. The exposed wall is of brick, faced with a mixture of 1 part Medusa white portland cement, 1½ parts coarse wash sand. These were brushed to give a rough texture on the face. The body portions of the faced brick and the brick of the inside wall are made of 1 part gray cement, 2 parts sand and 3 parts gravel. These are laid in mortar of equal parts of lime and gray cement mixed with sand. Mortar was raked out of the joints to a depth of ¼″ on all of the exposed wall surfaces. Lintels over all openings are of 3″ x 3″ steel angles. Plastering was applied directly on the brick walls. The house is roofed with red cedar shingles stained green. There is a fireplace of buff granite faced brick. The interior woodwork is of oak. The house complete cost about $4,500.

Hollow Walls of Precast Slabs[1]

Fig. 1—Slabs Cast in Background; Being Erected in Foreground

The accompanying illusrations show a new system of wall construction—the Harp system, developed and patented by Charles B. Harp, Los Angeles, Cal. The walls are erected with slabs set to form a continuous air space 4″ wide and bonded for stiffness or rigidity.

The slabs are of precast, reinforced concrete, assembled in the wall, the metal ties used receiving the strain, and in all cases the concrete serving only in compression.

This system is covered by a basic patent on the method of producing rigidity or stiffness of the wall without reference to material used.

Fig. 2—House Ready for Finish of Stucco

[1] Concrete, May, 1918.

Mr. Harp states the advantages of the system as follows:

Easy application of reinforcing rods, or mesh, in each unit; casting flat where units remain until hard; permitting use of mix of proper consistency; rough cast on face of slab to receive the plaster finish, insuring a good bond; use of unskilled labor in casting the rough slabs and erecting walls; flexibility permitted in the architect's plans; speed of erection; possibility of decorative features; elimination of patented forms; low cost.

Forms are used as shown in left background, Fig. 1, 4″ x 6″, of a temporary nature. There was 150′ of lumber, board measure, wasted in casting the walls of the house shown. Other data bearing on this house job are:

5,500 lin. ft. of 15/64″ round rods as reinforcing; gravel at $1.70 per yd.; sand at $1.70 per yd.; cement at $2.60 net on job; building 15 miles out of Los Angeles.

Fig. 3—House Complete; Bulit by Harp System of Hollow Wall Construction

Featherweight Units for Houses[1]

The Sawyer unit system of construction is being developed with considerable success by Klein Bros. Co., Dallas, Texas, for residence and other building work, as shown by the accompanying illustrations.

This system of small, thin, featherweight units, locking together in the wall and stiffened by reinforced concrete ribs, has previously been described in this magazine.[1] The details of the system are clearly shown in Figure 3.

Of the operations with this system, Klein Bros. Co. says:

Fig. 1—Residence of J. W. Kimbrough, Dallas, Texas; Built of Concrete, Sawyer System, by Klein Bros. Co.

Fig. 2—Four-Apartment Concrete Building of R. H. Clem, Dallas, Texas; Sawyer Unit System

[1]From Concrete, January, 1918.

We have constructed about 20 buildings here in this city, ranging from small office buildings to four-apartment structures, and from a small one-story building to one covering almost a block, containing eight stores and 20,000 sq. ft. of floor space. We firmly believe that the Sawyer system products are far superior to hollow tile, being stronger and more durable.

We have about $20,000 invested in a manufacturing plant; we first purchased a large coal oil burning engine of 50 h. p., costing $1,400.00; put in large concrete mixers and chutes, elevated so that the concrete would pour ridectly into the molds; we put in a large vibrating table at a large cost; also tracks, hand cars, etc. (see Fig. 4)

The slabs are made in a plural mold system of several hundred at a time; molds stand on end, the back on one mold makes the face of the other; these molds are placed on the car; the car rolled on to the vibrating table, and as the concrete is being discharged from the mixer the table is in a quick vibrat-

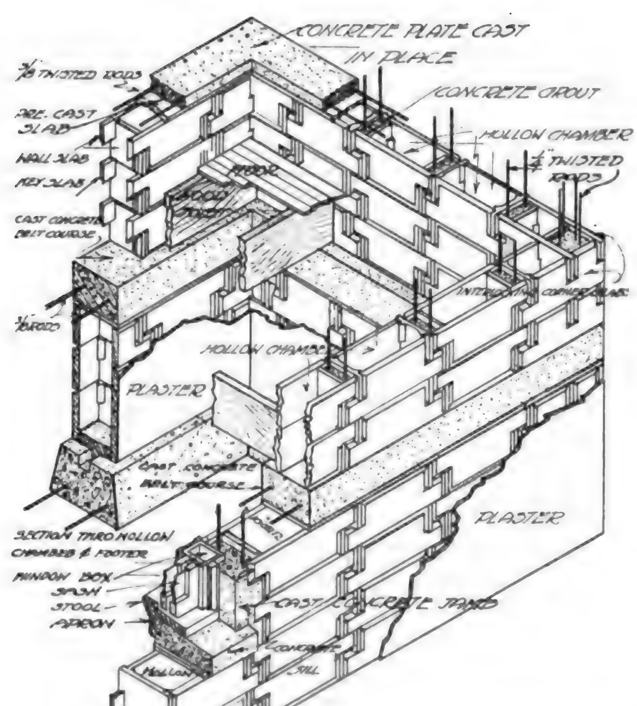


Fig. 3—Detail of Sawyer Unit System Construction

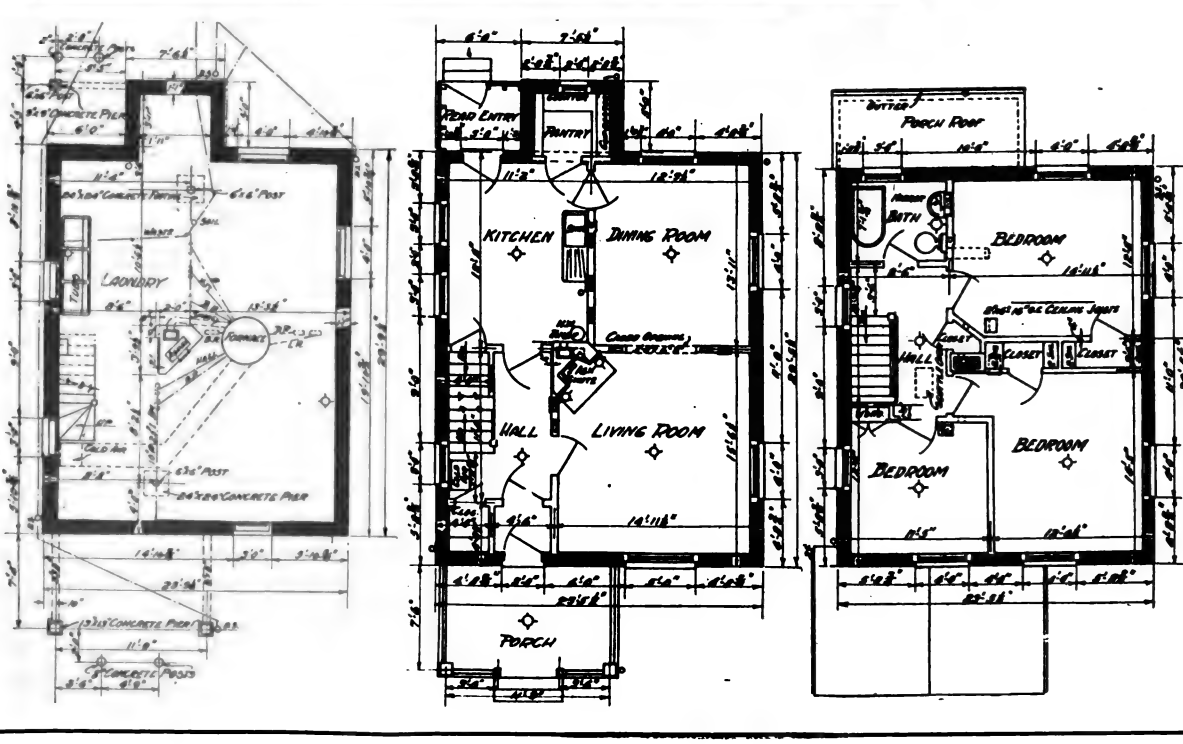
Fig. 4—Construction With Featherweight Units in Progress

Fig. 5—House Nearly Ready for Stucco

ing motion, which causes the concrete to settle into a very dense mass, shaking out all voids and air bubbles. When units are taken out of the molds, they are placed in large concrete vats for six days. The slabs are put up in the wall and are held by concrete keys made in a dove-tail shape, so that the higher the wall is built and more weight is placed on the walls, the tighter the slabs hold. A reinforced concrete stud is poured every 18". The construction can all be put up with unskilled labor; all put up dry without mortar, the only mortar being used is in the studs. This construction makes a well insulated wall. At the top of each story a solid reinforced plate is poured around the entire building. The cost of this construction is about the same as or a little less than brick or hollow tile.

Typical Concrete Block Houses at Morgan Park, Duluth, Minn.

The House Illustrated from Photograph and That Shown in Plan Are Not One and the Same, But They Are Similar and Typical of Houses Built for Minnesota Steel Co., with the Hydro-Stone Type of Block



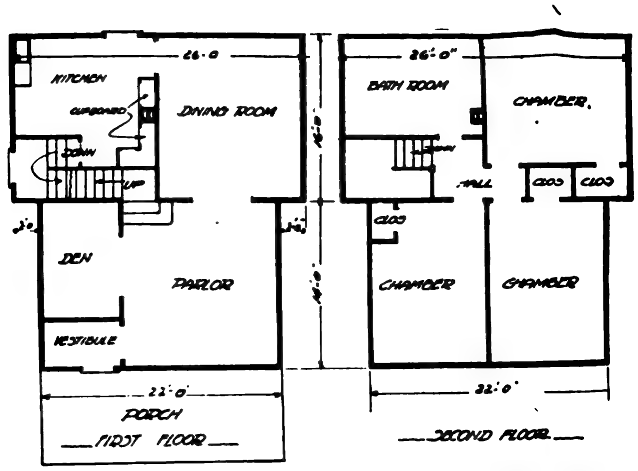


FIG. 3—FLOOR PLANS, CONCRETE BLOCK HOUSE COSTING $2,500

Concrete Block House With Double Wall

The 7-room concrete block house shown in the accompanying floor plan and in detail in the drawing, was erected at Lake Geneva, Wis., by the Cement Stone & Brick Mfrs. A distinctive feature of the house is the large wall unit, using 12″ high block.

All of the walls are of double construction, with an air space. The basement walls are 5″ thick on the outside and 5″ thick on the inside, with a 2″ air space. Above the basement level the walls are of 5″ block on the inside and 4″ block on the outside, also with a 2″ air space. The block in the basement walls, both sides, are 8″ and 24″ long, and the block forming the inner wall above grade are also 8″ high, while those on the outside are 12″ high and 24″ long. All the block were made on a Hobbs machine. Plain block were, of course, used below grade, and rock face granite block were used in the exposed portion of the foundation up to the water table. Panel face granite block were used over the water table to the scond story height, with stucco on plain block from there to the roof. The porch columns, baluster work and other ornamental pieces were made in Simpson molds.

In laying up the walls, wall ties were used with ¼″ round material bent at each end. Manufacturers, in figuring the cost of the house, added to the cost of materials and labor a profit of 30%, this covering the manufacturing end only of the concrete work. The units required are listed as follows at the retail price (1914):

940 solid stone, 5″ x 8″ x 24″	$108.40
1,500 solid stone, 4″ x 8″ x 24″	150.00
218 solid stone, 4″ x 12″ x 24″, using a facing of granite and white cement	54.50
352 solid stone, 4″ x 12″ x 24″, granite face	88.00
10 window sills and caps, 3′ 8″ long, 4″ thick, 12″ high	15.00
15 window sills	13.50
80 pier stone, 4″ x 12″ x 12″, granite face	12.00
5 porch columns	30.00
28 chimney block, 4″ x 8″ x 20″	5.04
80 baluster block, 4″ x 4″ x 12″, rock face, two sides	8.00
202 lin. ft. water table, 5″ thick, 6″ high	50.50
25 lin. ft. hand rail	3.60
	$528.64

This gives a total of $528.54.

The excavation cost $40.00.

The mason work is itemized as follows:

Mason and laborers at $5.00 and $2.25 per day of 8 hours, respectively, laying block	$210.00
Pointing walls	30.00
Sand, cement and lime for laying block	28.00
	$268.00

This gives a total, including mason work, materials and labor, of $796.54.

Rough lumber and mill work cost $565.00.

Carpenters at $4.50 a day of eight hours, $360.00.

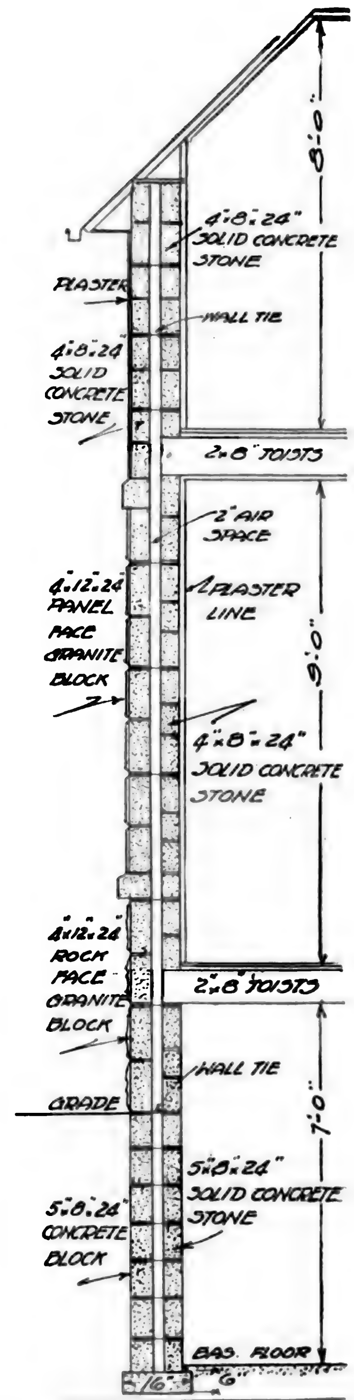


FIG. 2—WALL SECTION OF CONCRETE BLOCK HOUSE

The stucco on the upper walls is in two coats—one of ordinary gray cement and a finish coat of white Medusa portland cement and silica sand, with a cost, including labor and material, of 70 cts. per sq. yd.

The interior walls are plastered directly on the block, the air space being continuous. The roof is covered with shingles stained green. It is understood that the house made such a satisfactory appearance that the same company has had to build four more similar houses since.

[1]From CONCRETE, Jan., 1915, p. 44.

FIG. 1—TWO VIEWS OF RESIDENCE AT MOOSEHEART, ILL., BUILT OF FACED CONCRETE BLOCK AT A SAVING OVER FACE CLAY BRICK OF 19.7%

Concrete Block Used in Attractive and Economical House Construction[1]

The accompanying floor plans and illustrations from photographs show the residence and office of the dean at Mooseheart, Ill., being one of the many buildings with walls of concrete block which are being constructed in a large group by the Loyal Order of Moose, as a philanthropic and educational institution.

The manufacture of these block and their use in construction work, with detailed costs, have been described in previous articles[2] by R. F. Havlik, who is in charge of the work.

[1]From CONCRETE, Jan., 1915, p. 15.
[2]CONCRETE, July, 1914, p. 16; Aug., 1914, p. 55.

Mr. Havlik supplies the present data and plans.

The building is 33′ x 33′ in plan, with two stories and a basement, but in reality it is a three-story building without a basement. The entire interior of the building is plastered so that it consists of 12 finished rooms and a large bathroom. There is a sleeping porch approximately 8′ x 28′, a large front porch of the same size, three sets of concrete steps leading to the rear and the front porch, and to the Dean's office in the basement. The area-way leading to the office is faced with concrete on both the inside and the outside. The maid's room, the library and the office are trimmed with yellow pine

FIG. 2—BASEMENT AND FIRST FLOOR PLANS OF HOUSE AT MOOSEHEART

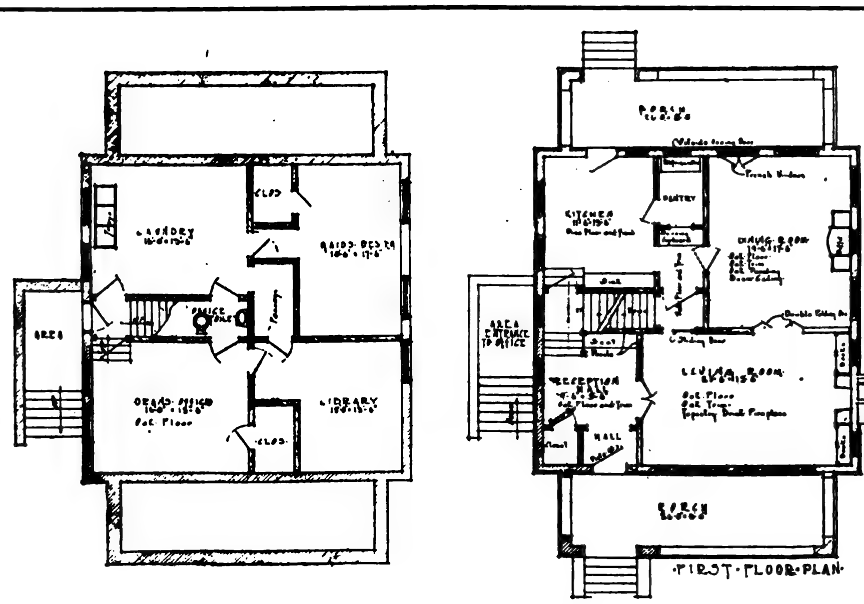


Fig. 3—Wall Construction with Two-Lug Block

and finished in natural color. The maid's room and the office are both floored with the best grade of clear oak, 7/8" thick. All of the basement rooms are plastered with two coats of plaster, sand-finished. The inside stairway leading to the first floor is of oak. The reception room, living room and dining room are trimmed in oak, and the wood work is finished in old English. The walls of the dining room are paneled in oak. The kitchen is trimmed with yellow pine. The refrigerator is so placed that it can be filled from the outside.

All the porch floors are of concrete, but the inside floors are of wood construction.

All the floors of the first floor, with the exception of that in the kitchen, are of clear oak, 7/8" thick. There is a large fireplace in the living room, and elaborate bookcases are built in on both sides of the fireplace. The dining room has a finely finished oak buffet, built especially to fit the room. French windows open from the dining room on to the rear porch.

Fig. 4—Detail of Basement Entrance

Fig. 5—Detail of Faced Block Surface

The second floor contains four large chambers and a large bathroom. Each room is supplied with a large, comfortable closet. The two rear bedrooms open directly on the sleeping porch. All of these rooms are trimmed with clear birch and stained a mahogany color, wax-finished. In building this house it was felt that it would be more or less of a public building, because the Dean would be required continually to entertain a large number of visitors, so it was considered advisable to build as pretty and comfortable a home as possible. Therefore, no expense was spared in this building to attain this end. For this reason total costs are of little consequence in a considerátion of the economy of concrete.

The roof of the sleeping porch is covered with 16-oz. copper. The front porch and the roof of the main building are covered with Spanish red tile. Future residences of Mooseheart will not be so elaborate internally as this one, as a residence of this size is far too large for the ordinary family, but this is an excellent example of the character of work that can be done with the Mooseheart concrete block and trim stone. In general this building represents the type of building that will be put up at Mooseheart for residential purposes. All of the block used in this building were made by the Hydro-Stone process, faced with mica spar crystals. Universal portland cement is used for all the granite block and for the backing of the trim stone. Some of the trim stone used at Mooseheart has been faced with Medusa white cement and some has been faced with Atlas white cement, both of which have proven satisfactory.

The block used in the Dean's home are of the two-lug type, giving a wall with a minimum thickness of about 2½" , and two projecting lugs on which furring strips are attached vertically by means of wall plugs or wire loops, held in the joints. The interior lath and plaster are then applied on the furring, giving a light yet stable and well insulated wall. All block used above ground on this house are faced, and washed and scrubbed while green to expose and brighten the facing aggregate.

Fig. 1—The Residence of Rafael Ferres, Miromar, P. R.

Fig. 2—A Bungalow for James Nobles, Miromar, P. R.

Fig. 3—The Henry Molina House, Condado, P. R.

Fig. 4—The Residence of Antonio Nechodomo, Architect
Sr. Nechodomo has designed a large number of houses similar to those illustrated.

The Construction of Small Concrete Houses at San Juan, P. R.[1]

By Earl K. Burton
Truscon Steel Co., San Juan

Since the inauguration of reinforced concrete residences of the bungalow type in Porto Rico some five years ago, they have gained much favor among Porto Ricans and American residents of the Island. This type, which is exemplified in the accompanying illustrations, is the standard of construction in the residential district of San Juan known as "El Condado."

This modern reinforced concrete dwelling is in marked contrast to the type of Porto Rican residence formerly built and still in use to a large extent. The old structures usually consisted of very heavy brick walls ranging in thickness from 18″ to 24″ and plastered both inside and outside with a mortar of pulverized brick and natural cement. Occasionally one would find the interior partitions of the same thickness as the outside walls, although they supported only the roof. This type depended for durability and strength upon its massiveness only. The arrangement of the interior was very simple, usually rectangular in shape, with one hall or passageway extending the entire length of the building and with rooms located symmetrically on either side of the hall.

The modern dwelling, the construction of which is here described, is architecturally similar to the American bungalow. Its outside appearance would seem identical with bungalows in California and other parts of the United States, and essentially it is, but several features are included that make it distinctive, both from necessity and from local artistic temperament. For example, shutters are installed in nearly all window openings. They permit practically 100% ventilation, and at the same time diffuse the intensely bright sunlight. Also, the Porto Rican is a lover of tile floors and of colors that give contrast. Tile floors will be found in some parts, if not all, of the house, and faience tile panels are inserted in the outside walls. The living room and

[1]From Concrete, September, 1915.

FIG. 5—A GROUP OF CONCRETE HOUSES AT "EL CONDADO," PORTO RICO

the dining room are generally thrown into one large room, there being either a wide arch or columns and grill separating them. These are customs that have prevailed in Porto Rican homes for years.

STRUCTURAL FEATURES

The footings and the outside walls are constructed of reinforced concrete, the latter extending to the full height of the building. The footing usually consists of a solid course of concrete 9″ to 1′ in thickness and 2′ 6″ to 3′ 6″ in width. In some cases footings have been placed in filled ground below sea level and very close to the shore, in soft sand. This has necessitated the construction of a spread footing of unusual width and depth, heavily reinforced. Such a footing acts in the same manner as the so-called "raft" foundation. A footing wall 10″ thick extends from the footing to the floor line, and is offset here to form a belt course around the building on the outside and a bearing for the floor joists on the inside. For one-story structures the wall above the floor has been constructed of reinforced concrete 4″ thick or of metal lath and plaster on studs. In the latter, the wall is 6″ thick. The footing and footing wall concrete is mixed in the proportions of 1:3:6, using American brands of portland cement, river sand, if possible, but usually sea sand, and broken stone (a blue trap-rock of excellent quality), ranging in size from ½″ to 1″. The footing and footing wall are poured monolithic around the entire building, and the former is reinforced with from three to five ¾″ bars longitudinally and ½″ bars transversely, spaced 24″ o. c. The footing wall is reinforced with ½″ bars spaced 12″ horizontally and 24″ vertically. The 4″ concrete wall has the same reinforcement as the footing wall. Four inches may appear thin for a wall supporting a roof, and it would seem that it would be hard to pour so as to obtain a smooth surface and to eliminate the "honeycombs." The latter objection is overcome by the use of a mixture of portland cement and screenings mixed 1:5. The screenings are the hard trap-rock mentioned above and range in size from ¼″ to the smallest particle. This mixture gives a very smooth wall and little additional work is necessary after the removal of the forms. While such a wall is durable, yet its compressive strength is rather low, but experience has shown that it is amply strong to support a roof of ordinary wood construction, the type which is ordinarily used. With a roof of heavy tile, such as is shown in Figs. 1 and 6, the use of a 4″ wall would not, in the writer's opinion, be considered good practice where the outside walls carry the entire roof. As an added factor of safety, and to prevent cracks that have occasionally appeared in the

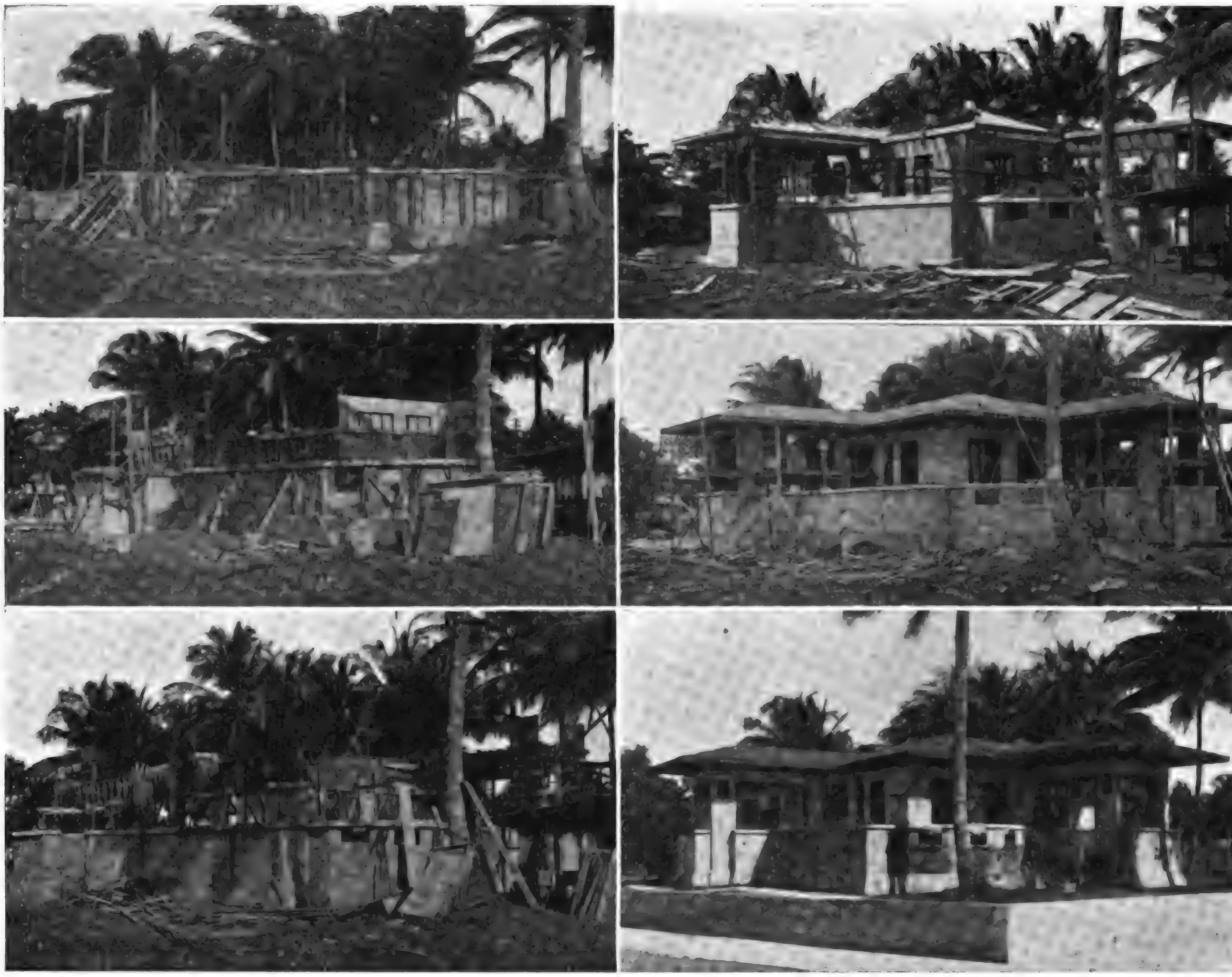


FIG. 6—CONSTRUCTION VIEWS OF HOUSE FOR BEHN BROS., EL CONDADO, PORTO RICO

4″ walls, specifications that call for a solid concrete wall have been changed to a 6″ wall. The chief advantage of the use of screenings is the pleasing texture of the finished surface.

The concrete is mixed by hand to a wet consistency and the wall is poured in courses 3′ high around the entire outside. The forms are removed 24 hours after pouring the concrete, and the wall, while still "green," is rubbed down with a wooden float. In this way the rough spots are eliminated without discoloring the surface. For such a thin wall special care is exercised in placing and bracing the forms to keep them true and plumb.

Floors—The floor is usually constructed of wood, using joists 2″ x 8″, 18″ o. c., supported at the outside on the footing wall and at the center on a girder set on concrete posts. One inch sheathing is laid directly on the joists and the finishing flooring after the other parts of the building is complete. If tile floors are specified, the tile are laid on a concrete base over a well packed earth fill. The floors of the bath room and of the kitchen are generally of tile and concrete respectively. The top surface of all concrete floors is treated with a hardener to prevent wearing and dusting.

Partitions—All interior partitions are constructed of Hy-Rib and plaster, except where a center support is necessary for the roof joists, in which case the center longitudinal wall is of solid concrete. The partitions are 3″ thick and are laid directly upon the wood floor, the floor joists being doubled under the partition. They are reinforced at the corners and at the sides and the top of door openings with 1½″ structural channels vertically, and ¼″ round rods, attached to the Hy-Rib,

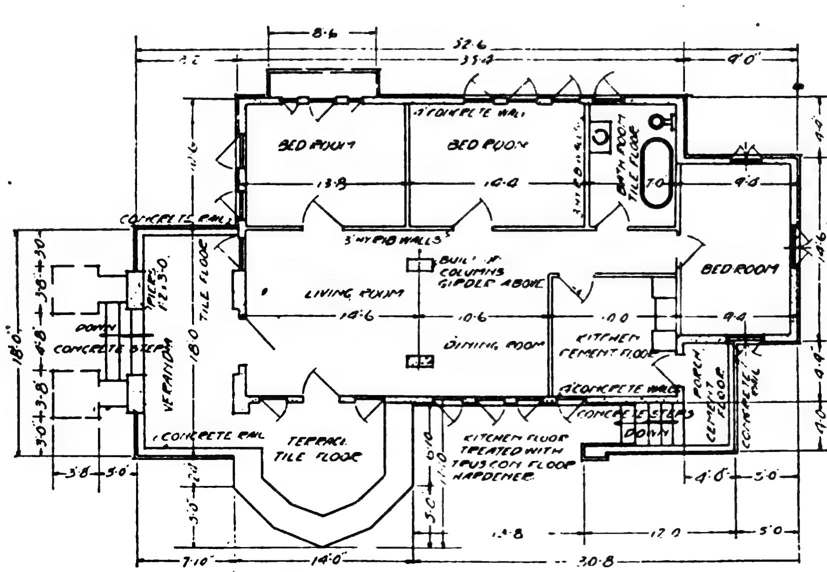


FIG. 7—FLOOR PLAN OF BEHN BROS. HOUSE

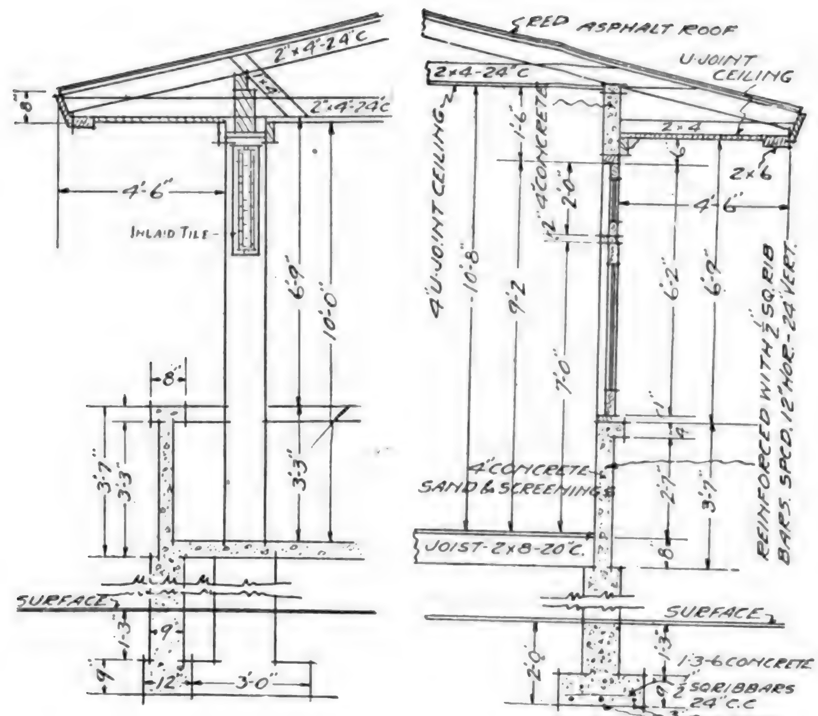


FIG. 8—DETAILS OF CONSTRUCTION

horizontally, 18″ o. c. The mortar applied to these partitions consists of 1 part of portland cement, 3 parts of sand and a small amount of lime, usually 10% of the cement. The interior of the outside walls is also plastered to conform in color and texture to the plaster partitions.

All concrete and plaster are waterproofed with an integral waterproofing, as well as all concrete floors that are laid on the ground.

Roofs—If the width of the building will permit, the roof joists span the outside walls. Roof construction is of the ordinary frame type and is clearly shown in the accompanying plans. The roofing material used depends upon the fancy of the owner, and is of asphaltic paper, metal tile, Spanish clay or vitrified tile. The clay tile are not used to a very large extent, owing to their exceptionally high cost. The pitch of roofs is very flat and the overhang varies from 3′ to 4′, either ceiled or left open. If ceiled, special care is taken to allow circulation in the attic by providing at intervals screened openings in the ceiling.

Details of Finish—The tendency of the Porto Rican is toward rather bright colors and panels of faience tile are inserted in certain parts of the outside wall, usually on the sides of columns and at the lower corners of windows. These panels are shown in the accompanying views. The windows are a very important factor in the construction of these dwellings, as it is imperative to obtain the maximum ventilation and, on the other hand, not admit too much sunlight. As before mentioned, this is ordinarily accomplished by the use of shutter windows. These windows are also generally placed in groups so that when they are open the room will practically be converted into a veranda.

These residences contain nearly all of the conveniences of a modern suburban American home, such as water service, electricity, gas, etc. However, except in the business district of San Juan, there is no sewerage system. Sanitation, therefore, requires that each residence must dispose of its sewage. The system consists of two tanks placed well underground, one of them constructed of concrete and practically air-tight. The second tank is constructed of loose stones, through which the sewer water percolates. The solids are retained in the first tank and the fluid is drained into the second, where it seeps out through the ground. The airtight tank will require cleaning about once a year, and the outlet tank, if constructed properly, will never require any attention.

These residences are in the residential park, "El Condado," which contains practically all the homes of this type. The dwellings are designed by local architects and are built by local contractors, either under the supervision of the owner or through Behn Bros., who are financing the development of this section.

COSTS

It is rather difficult to obtain unit cost figures. Very few contractors keep a cost system in a systematic way and consequently most of them cannot give the cost of a certain kind of concrete on the unit basis. However, the following figures are an average of most of the structures illustrated and represent quite closely the actual cost (1915):

LABOR AND MATERIAL COSTS, CONCRETE RESIDENCES IN SAN JUAN, P. R.

Materials (Cost at Job):	
Cement, per bbl. gross (less 28 cts. for return of 4 sacks)	$1.80
Broken stone, ¾″, per cu. yd	$2.80
Stone screenings, ¼″ to dust, per cu. yd	$1.15
Sea sand, per cu. yd	50 cts.
River sand, per cu. yd	$1.90
Rough dimension and sheathing lumber, per 1,000 b. m	$28-30
Finished Y. P. lumber for formwork, per 1,000 b. m	$30-32
Quarter-sawed Y. P. flooring, per 1,000 b. m	$65-70
Reinforcing steel, per ton base	$41.50
P. R. mosaic tile for floors, per sq. yd	85 cts.
Red quarry tile for roof (U. S. mfre.), per sq. yd. of roof	$2.50
Holland clay tile for roof, per sq. yd. of roof	$1.20
Metal lath for partitions, with studs, per sq. ft	2.5 cts.-3.0 cts.
Hy-Rib or similar for solid partitions, per sq. ft	5 cts.-7 cts.
Labor and Materials:	
Footing concrete, 1:3:6, labor and materials, per cu. yd	$9.00
Wall concrete, 4″-6″ thick, labor and materials, per cu. yd	$18.00
Floor concrete on earth fill, labor and materials, per 100′ (5″ thick), (no top dressing)	$12-14
Hy-Rib partitions, 3″ thick, per sq. yd	$1.75
Studded partitions, 6″ thick, lath and plaster both sides, per sq. yd.	$2.00
Plaster and concrete, ¼″ thick, per sq. yd	35 cts.
Rub finish, on outside wall (where not plastered), per sq. yd	13 cts.
Finished wood flooring, labor laying, per sq. yd	13.5 cts.
Finished wood flooring, labor finishing and scraping, per sq. yd.	16.0 cts.
Wood floor joists, 18″ spacing, labor, per 1,000 b. m	$20.00
Tile floor, labor, per sq. yd	$1.00
Peon labor, per hour	10 cts.-12 cts.
Carpenters, per hour	25 cts.

Average cost of buildings, complete, including plumbing, electric work, etc., for one-story residence as described in article, is $1.75 per sq. ft. of floor area, including balconies.

FIREPROOF RESIDENCE OF DR. F. W. DUDLEY, NEAR MANILA, PHILIPPINE ISLANDS — BUILT OF CONCRETE AND STEEL

FIGS. 1, 2, 3—EXTERIOR VIEWS

FIGS. 4 AND 5—SLEEPING AND LIVING PORCHES

Fig. 6—Large Residence of Dr. F. W. Dudley, Near Manila, P. I.—Walls, Floors, Roof and Stairs of Concrete

Philippine Island Concrete House[1]

The house shown in the accompanying illustrations was erected in the Philippine Islands, five miles from Manila, for Dr. F. W. Dudley. It stands in a beautiful 7-acre tract, 152′ above the city. The work was done on force account by native labor, under the direction of an American foreman, and is practically fireproof throughout.

The house is of concrete and steel, the only wood in the structure being used in the framing for the kitchen roof, for window and door frames, for doors, windows, stair rail cap, dumb waiter box and the shelving in the closets. The interior trim is especially interesting, representing many native woods, beautifully finished in natural colors. Columns, walls, floors, roof and the stairs are of concrete. Some steel I-beams were employed.

The concrete is of a 1:2:4 mixture throughout, employing Green Island (Hong Kong) portland cement. The reinforcing consisted chiefly of ½″ square twisted rods in 30′ lengths. A few ¾″ square twisted rods, however, were available.

The design was so worked out by Dr. Dudley himself that much of the form work was good for three uses, at the end of which, however, it was practically useless. Materials were raised by hand hoist.

Much of the concrete was waterproofed by adding 5% of mineral oil, according to the directions worked out by the United States Office of Public Roads. The building was erected in five months in the rainy season, to get the benefit of good curing conditions, and in the first succeeding dry season the concrete roof slab was covered with 5″ or 6″ of sand, and kept damp, and since then only two or three small cracks have developed in the subsequent dry seasons.

It was originally planned that, while all the floors should be of concrete, they were to be covered with linoleum, cork carpets and other special surfacing materials. Due to war conditions, however, these were not obtainable, and as this condition became known before the floors were finished up, mortar color was incorporated with the last ½″ of the 1″ top surface, which was mixed of 1 part cement and 2 parts sand, and the results are entirely satisfactory. The top was troweled down smooth. The floor treatment is described by Dr. Dudley as follows:

Fig. 7—Dining Corner of One of the Large Porches

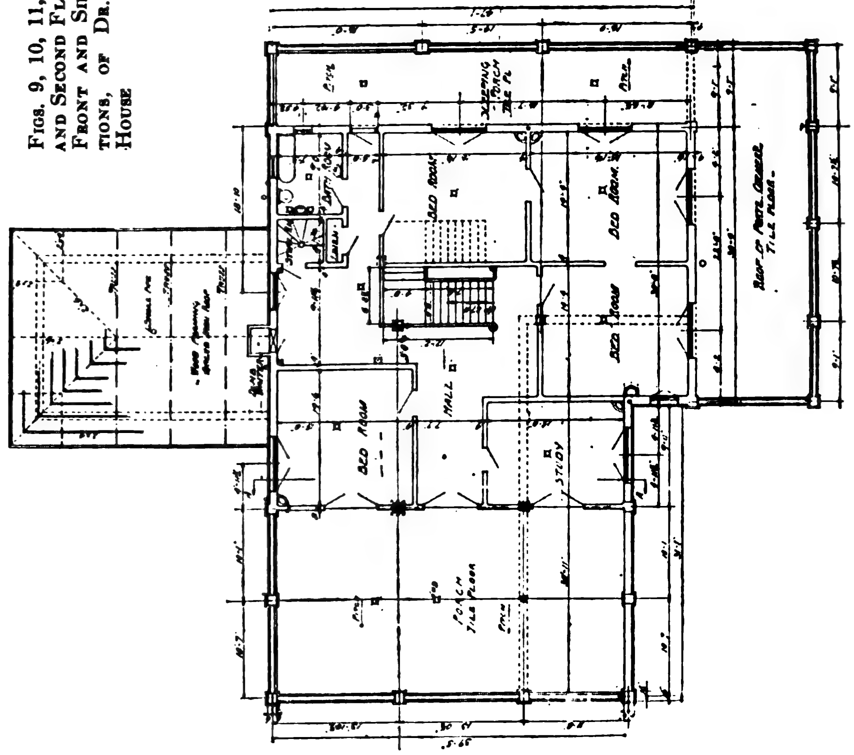
We clean the floors thrice weekly with a 5% solution of Sig. Cresol Comp. U. S. P., the formula of which is as follows:

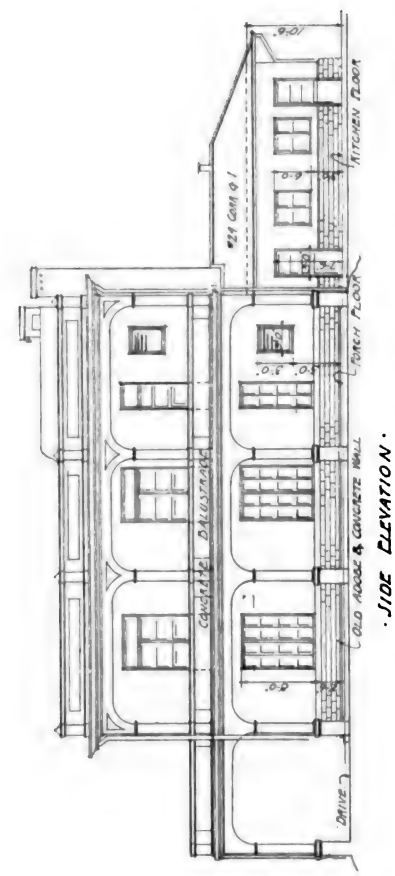
Cresol	500 grams
Linseed oil	300 grams
Potassium hydroxide	80 grams
Alcohol	30 milliliters
Water sufficient to make up to	1,000 grams

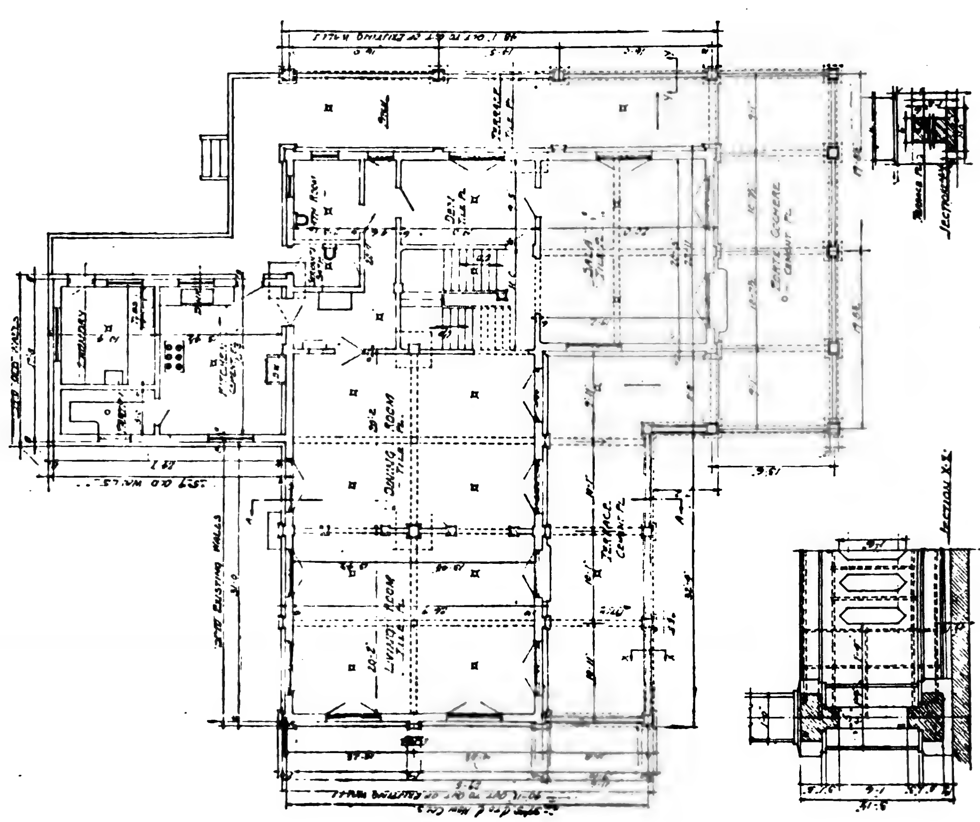
Fig. 8—Interior, Showing Arched Opening

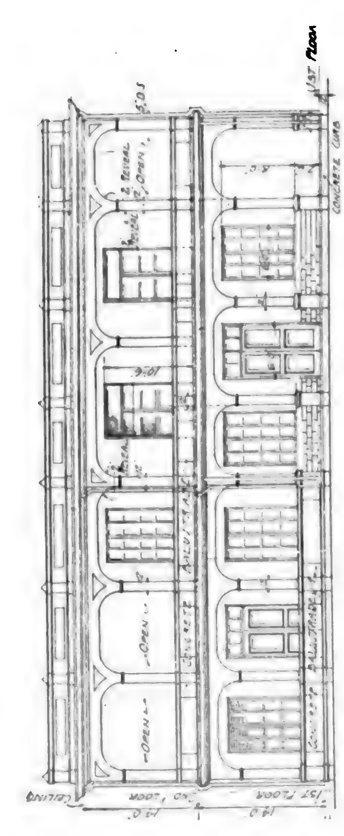
[1]Concrete, April, 1919.

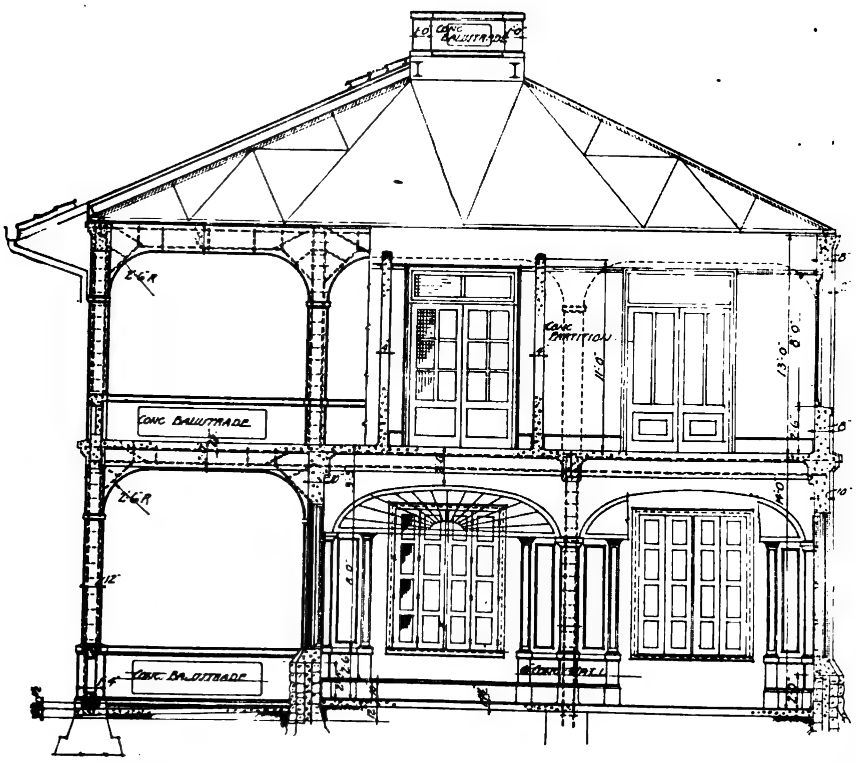
FIGS. 9, 10, 11, 12—FIRST AND SECOND FLOOR PLANS, FRONT AND SIDE ELEVATIONS, OF DR. DUDLEY'S HOUSE

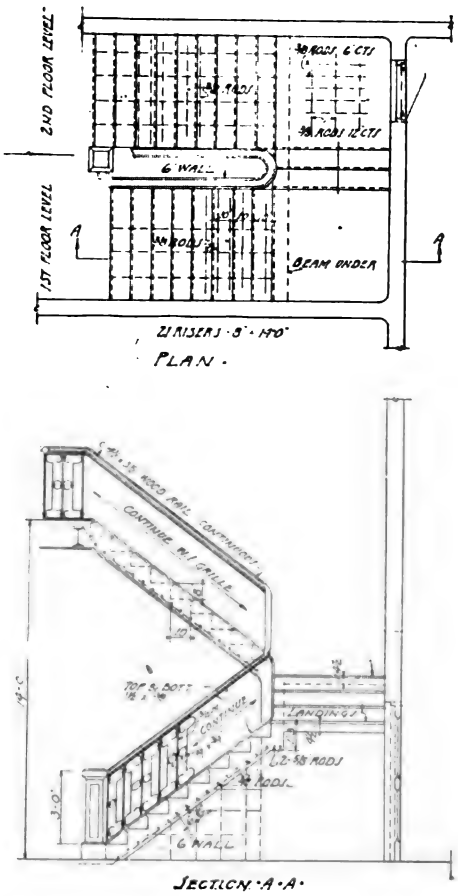












FIGS. 13 AND 14—SECTIONAL VIEW OF HOUSE, SHOWING WALLS, FLOORS, COLUMNS, ETC., AND A DETAIL OF STAIRWAY OF CONCRETE

This is a rather difficult formula to mix, so do not try to make it yourself. If you want a small quantity, your local druggist can probably furnish it; if you want large quantities—from a gallon up—buy it from a wholesale druggist, or a reliable pharmaceutical manufacturer.

Floors are mopped daily with the following:

Kerosene	120.0 c. c.
Good soap	250.0 g.
Turpentine	60.0 c. c.
Boiling water	6.0 liters

The floors are swept clean and all dirt and dust removed.

After mopping on alternate days with Sig. Cresol Comp., U. S. P., and hot water, the above mentioned solution is applied hot, after emulsifying. This last solution is used several times a day and well rubbed in with a piece of blanket in a mop handle, till the floors take on a beautiful polish.

These floors are so satisfactory that no special coverings will be provided.

The 5,250 gal. concrete water tank on the roof of the house was waterproofed with 5% of mineral oil.

The walls of the house for the first floor are 10″ thick, and the second floor 8″ thick. The house is described as cool and comfortable in the hot season, and dry in the extremely rainy season.

The exterior concrete was gone over with a steel brush as soon after casting as possible, and it was then given a cement wash. The inside of the house is sand finished, the paint and tinting being applied direct.

In still another respect the house is unique in that a great deal of native shell is used in windows, instead of glass. The shells are white, translucent, about 2½″ square, and are held in place by wooden strips. They are set diamond shape in frames and appear not unlike ground glass.

The stairs, of concrete, are finished red with iron balusters and a native wood cap rail.

Much special imported glass was also employed. The house cost $42,500, American money.

Engineer Builds Economical Concrete House With Simple Equipment[1]

The house which is the subject of this article is valuable as an illustration of what can be done with concrete by an individual not equipped with commercial forms, who expects to build his own residence only. J. F. Hahn,[2] who has for some years been engaged as designing and constructing engineer on various classes of reinforced concrete work, was in the same position as many others; he realized distinctly the advantages of a concrete house, yet was confronted with the impossibility of securing a favorable contract price as compared with other materials, owing to the unfamiliarity of most builders with this class of construction.

The house is from the owner's plans and was constructed under his supervision. It is as shown by the illustrations, extremely plain in outline, but it is well proportioned and well suited to its surroundings; situated on an elevation among stately old trees, its simple, strong lines stand out in a particularly favorable setting.

The house is 25′ x 36′ in plan, the basement height from floor to floor is 7′ 8″, the first story 9′ 6″, the second story 8′ 6″. There are a front porch, a rear porch and a sleeping porch. The house contains nine rooms and a bath, besides the basement and the attic.

[1]From Concrete, Jan., 1916, p. 3.
[2]Civ. Engr., Jackson, Mich.

As will be seen by the plan, the living room and the dining room occupy the entire front. In the living room is a concrete brick-faced fireplace. The entrance is protected by a vestibule. At the rear of the first floor are the library, the sewing room and the kitchen.

The second floor provides four bed rooms and a bathroom. Ample closet room is provided, including two linen closets. From the hall access is provided to the sleeping porch at the rear of the house and to the attic, which contains a large amount of storage space and could, if necessary, be divided into three sleeping rooms. The basement is subdivided by concrete partitions which support the main partitions and the first floor. Aside from the usual space for heating plant and fuel storage, there are a good sized laundry and a store room in the basement.

Concrete

Concrete was of bank-run gravel, with the larger stones removed. A considerable amount of the gravel was found at the excavation and was used in basement walls and the first floor. This reduced the cost of gravel to about 85 cts. per cu. yd. for the entire building. Cement was used to the amount of about 175 bbls. and cost $1.50 delivered at the job. A continuous mixer was rented for the work.

Figs. 1-4—Front, Rear and Side Views of Residence of J. F. Hahn

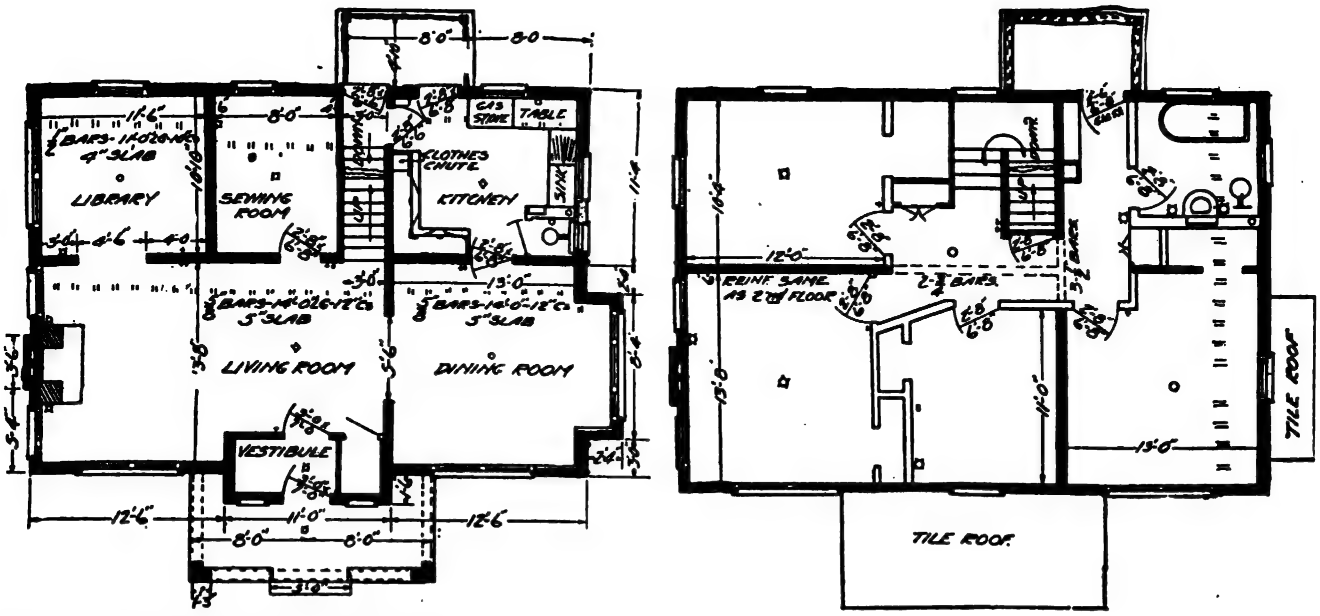


FIG. 5—FLOOR PLANS, SHOWING STEEL USED

All concrete above the basement walls was mixed approximately 1:4½, cement and pit-run gravel. The concrete was very dense and practically waterproof.

Reinforcing—The walls were reinforced horizontally with ⅜" twisted bars 16" o. c., and the same size bars were placed around openings.

The reinforced concrete floors are supported on concrete bearing walls except for short spaces carried on girders as shown on the plans. The floor slab was reinforced with square twisted bars of size and spacing shown.

Forms—The wall forms for the superstructure were sectional, 2' 6" high, made of 3" x 10" boards nailed to 2" x 4" pieces at about 2' 6" centers. Inside and outside forms were held in place by 5/16" bolts and spreaders. The inside of the outside forms was covered with a cheap grade of 2-ply roofing felt having a rough grained surface. The roofing felt was used to avoid the smooth, glassy surface characteristic of concrete where smooth wood or steel forms are used. The paper also served as a gasket between the forms and the concrete wall previously built, and in nearly all cases the form was watertight and made a joint that is barely noticeable. After the concrete work was finished, the forms were taken apart, the boards were used for roof sheathing and the 2" x 4" pieces for fillers in second floor partitions. The rafters and the second floor ceiling joists were used for supporting floor forms and for staying. In this way all the lumber that could be charged to forms is the waste from cutting, which did not exceed 500 board feet.

Handling Concrete—The concrete was handled by hand and no hoisting equipment or runway was used. As the concrete was poured in sections about 30" high, the first section was easily handled with buckets from the ground. The second section was poured by a man standing on a portable platform, who took the bucket as passed to him from a laborer on the ground. The platform was moved along as the forms were filled. The same procedure was followed by adding an additional man for each rise of the forms, up to the second floor, when the material was hoisted to the second floor by three men at the rear porch and the procedure was repeated. While this may seem a crude way of handling the concrete, when one considers the very small quantity that is required for a 6" wall, 30" high, allowing for openings, and that this was an isolated job which would not warrant an investment for staging equipment, it will be found that this was probably as economical a procedure as could have been followed. The light mixer used was easily moved from one side of the house to the other, so that the concrete had to be carried a very short distance.

The first story required two days to set up forms and pour the concrete for each section, thus requiring 8 days to build a story height. The work was done by a superintendent, one carpenter and two laborers for the first two sections, three for the third, and four for the fourth. It required 6 hours to 7 hours to set up the forms and 2 hours to 3 hours to fill them with concrete. The work was so arranged that all forms were filled at the end of each day. This part included the concrete partitions.

The second story walls, without partitions, were built in 4 days, or at the rate of a section per day. To pour the concrete, an additional laborer was employed for each additional section in height. The additional laborer was used only a few hours each day while pouring concrete, the local labor situation permitting this arrangement.

Surface Treatment

The forms, covered as previously described with roofing paper, did not leave the surface in a glassy condition, and there was comparatively little streaking from leakage. While the house looked rather spotted at first, two years' exposure to the weather has evened up the color to a remarkable extent, and the surface, which is practically as left by the forms, is far from unattractive. It has a sturdy individuality; it is an honest expression of an honest material, and will continue to grow more attractive as the years pass.

Roofing

The roof frame is of wood and in it were utilized the plank which had been serving throughout the job as staging and supports for floor forms. Practically every scrap of lumber could be used in sheathing the roof, so that there was very little waste. As roofing tile was to be used, the roof was prepared by covering with waterproofed paper, which was held on by lath running up and down the slope of the roof. These laths also act as furring strips for horizontal 1" x 2" strips, to which the tile are secured. The tile were made on a Brock roofing tile machine, which is a simple piece of equip-

ment consisting mainly of an arrangement for molding on pallets which give the proper shape to the bottom of the tile and a troweling member running on guides which trowels and gives the proper form to the top surface. The tile were first made to an approximate shape and then a surface coating of red iron oxide was sieved over them and the troweling finished. This gives a very good color which seems to be fully equal to that of the burnt clay tile, while irregularities in placing the color give variety in the depth of the shade, which results in a very pleasing roof. It is interesting to note that the tile were made and placed on the roof at about $12 per square.

Construction Details

Fortunately the mistake was not made in this house of attempting to secure a dry and thoroughly insulated building by means of a single concrete wall, and pro-

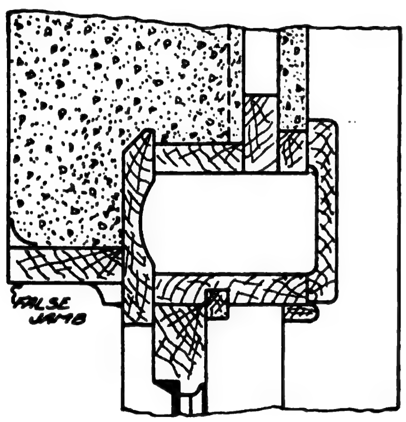


Fig. 6—Window Frame Details

vision was made for furring and lathing. This is done as illustrated in the sketch, by tacking V-shaped strips to the forms at proper intervals, to which vertical furring strips were afterwards nailed. The concrete partitions and first floor ceiling were not lathed, but the plaster was applied direct, with entirely satisfactory results. Considerable thought was expended upon a proper window frame detail, which should be simple and entirely weather-tight, yet which could be used readily with a 6″ wall and not interfere with the forms. The result of Mr. Hahn's work is shown in an accompanying detail. Study of the detail will show that the jamb, headpiece and sill could be separated from the rest of the frame and readily replaced. A false jamb was used outside, as shown, to act as a form for the concrete. This was, of course, removed and a staff bead put on after the forms were removed. Each frame was set assembled complete, then the jambs were match marked, numbered and taken off until the concrete work was complete. It will be noticed that this style of frame provides not only an airtight joint, and a form for the concrete, but also suitable nailing for the interior trim. The porches are of concrete poured in forms, but the panels in the rear porch are of stucco on ribbed metal lath over sheathing. The floor and roof of the sleeping porch are of poured concrete. The roof is colored with red oxide to match the roof tile; the iron oxide was troweled in as with roofing tile. The concrete sills were cast in place in suitable spaces left for them, it being considered easier to do this than to take care of the complications sills would involve in the form work. The chimney is of concrete, poured with the house and provided with square vitrified tile flue lining. The use of concrete has been extended to all the surroundings of the house, as will be noted by the long flight of concrete steps, the retaining wall, sidewalks and even the concrete lawn roller and T-shaped clothes line post which can be seen by close inspection of Fig. 2.

Interior Fittings

The finished floors are of oak and yellow pine, nailed to 2″ x 2″ screeds laid directly on the concrete subfloors, except in the vestibule and the toilet room, where ceramic tile floors are used. All partitions not indicated as being of concrete on the plans are framed of wood in the usual manner. The trim on the first floor is of oak of a plain and tasteful design, and the second floor rooms are finished in yellow pine, enameled, and birch mahogany. A vacuum vapor heating plant has been installed, which, together with the concrete construction, has reduced very considerably the fuel required for heating.

The kitchen and the laundry are piped with gas and in the laundry is installed a Diehl automatic water heater, which supplies hot water at all times to laundry, kitchen and bathrooms. The house is lighted by electricity and gas. The plumbing consists of toilet on the first floor and bath room on the second floor, with the usual equipment of kitchen plumbing, and an automatic soft water pump in the laundry. A clothes chute communicates between the laundry and each floor.

Cost

In estimating the cost (1915), the owner's time as superintendent is included at $4.00 per day, but no contractor's profit is added in the total cost, although it is figured on certain parts of the work which were let out on contract. It may be added, however, that this work was done at an exceptionally favorable time, and that the figures obtained from contractors were probably unusually low. The notable feature of this work is that, in spite of the fact that this was an isolated building, erected by workmen who had had little or no previous experience in this class of work, a fact which was, to a certain extent, offset by favorable prices for materials and favorable labor conditions, the cost of the concrete work, which includes the basement and entire structural part of the house, came to slightly more than $1,000. The remainder of the cost went into woodwork, millwork, plastering and accessories which would necessarily be figured at the same cost in any kind of house. It is evident, therefore, that not only this concrete house has not cost more than other types of structures, but in all probability Mr. Hahn has actually effected a saving over any other material. He has a house which will require no upkeep for years to come, which removes to a large degree the fire hazard as evidenced by the lower insurance rates, which is more easily heated in cold weather, yet is cool in the heated season, and which will continually become more in harmony with its surroundings as the years pass.

Cost Data

Excavation contract	$ 40.00	$ 40.00
Cement	266.64	
Gravel and sand	116.10	
Steel	79.85	
Mixer (rental)	20.00	
Labor on concrete and forms	578.00	
Total concrete cost		1,060.59
Roof tile and sheet metal contract	$ 286.00	
Plastering contract	228.00	
Lumber	528.19	
Mill work	158.49	
Carpenter labor	420.44	
Total lumber and carpenter		1,107.12
Hardware, rough and finished	$ 93.48	
Plumbing contract	308.00	
Heating plant	386.88	
Painting (does not include walls where left white)	183.45	
Electric light wiring and fixtures	108.40	
Hardware, heating, plumbing, light and painting		980.11
Incidental mason supplies		56.54
Miscellaneous labor		28.02
		$3,786.68

FIG. 1—RESIDENCE OF MRS. O. J. STEWART—BUILT FOR PERMANENCE AND COMFORT

A Concrete House With Tile-Lined Walls[1]

BY CHARLES F. DINGMAN

This concrete residence differs from many in that low cost was neither the first consideration nor the determining factor in the choice of a building material.

The owner demanded a residence which, for its size, should be strictly first-class and which should be fire-proof, comfortable, permanent, and gain its attractive appearance from harmonious proportions, rather than from architectural embellishment. Concrete was pre-eminently the material indicated by these requirements.

The architect, George W. Von Arx, has succeeded in producing a well proportioned, comfortable looking house, without excessive adornment.

The wall section shows the care taken to get a wall that should be damp-proof as well as a heat insulator. While this type of construction may seem excessively costly, it has been justified by the fact that in some places expensive paneled wood wainscot is placed against the wall and that the wall has proven an excellent heat and moisture insulator. The rods shown in the drawing were placed as an insurance against contraction cracks, rather than to add strength.

The floor construction is of the Kahn hollow tile and concrete type.

Cornices are of copper, to give a contrasting color, and the roofs are of red Spanish tile. The sleeping porch, shown unfinished in the illustration, has a glass roof set in puttyless sash, while the sides are made up of metal casements.

[1]From CONCRETE, March, 1916, p. 110.

Practically all of the concrete work was cast in place except the porch balusters, which were cast on the ground and set in place, after which the coping rail was cast on top. The walls were poured in wood forms, and are lined with hollow clay tile. All walls, after removing the forms, were ground to a surface as smooth as possible by the use of carborundum brick. Forms were left on until the concrete was comparatively hard, which made the cost of surfacing reach the rather high price of 8 cts. per ft. However, it is believed that this cost was justified by the fine appearance of the surface obtained.

The total cost of the house, excluding plumbing, heating, vacuum cleaner, electrical work and finished painting, was approximately 32 cts. per cu. ft., which is greater than the cost of a similar brick house, but considerably cheaper than a stone veneered house of the same style.

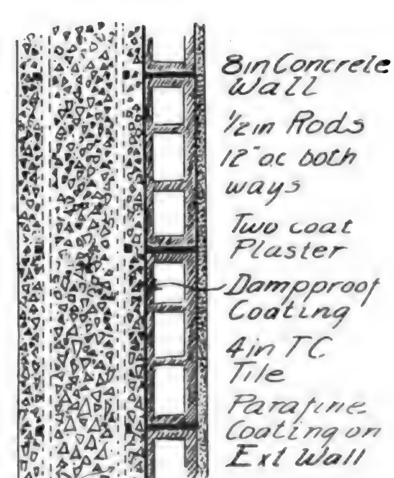


FIG. 2—WALL SECTION, STEWART HOUSE

The house was erected for Mrs. O. J. Stewart by the Merrick Fireproofing Co. Julius Bally was superintendent of construction, and the writer at that time was secretary of the contracting company.

House Walls Are Pre-Cast Horizontally[1]

By W. B. Heriot

The instincts of the architect and builder, developed by actual experience and the conception of an idea suggested by the need of greater efficiency in economy and fireproof construction, impelled B. Frank Davis, Miami, Fla., to attack the problem of unit-built structures along the line of walls cast flat on the ground, as shown in the accompanying illustrations, Figs. 2-5, and as finally worked out in the original demonstration in Fig. 1.

Fig. 1—Bungalow Built in Miami by New Unit System of Construction

The work consisted in making sectional walls poured into forms flat on the ground, eliminating much form work, waste lumber and labor, and admitting new architectural possibilities with a minimum of expense, the sections finally being lifted into place upon the foundations, spaced sufficiently apart to provide for pilasters that are molded into place, making a continuous or complete wall. The chimney also acts as a pilaster.

Details and cost data given by Mr. Davis follow:

The net cost of the walls (no contractor's profit included) finished with sienna coloring, pebble-dashed, pilasters plastered and tinted, was only 17½ cts. per sq. ft. This does not include porch work, which happened to be of an expensive design; it does include the four outside walls from foundation water table up, finished with 2″ x 2″ furring strips inside.

It took about the same time ordinarily consumed for similar size and design of walls in ordinary construction, but only one mechanic and two common laborers were required.

The system was used on the building illustrated as follows:

The foundation was laid (including basement) by the regular double form method.

The floor joists and sub-floor were then placed.

The window frames, double-hung, casement and doors with transoms, were laid flat upon the floor.

The walls were divided into convenient sections.

For each section (17 in all) a slab was cast, some having window or door frames cast in place and some without openings.

Furring strips 2″ x 3″, 16″ o. c., were laid down upon the sub-floor and nails driven into their top surfaces, heads projecting.

Loose 2″ lumber was then laid in between the furring to form a continuous flooring under the slab, 2″ above the sub-floor to allow for thickness of frames.

Two-by-four timber on edge formed the mold for the slab, the 2 x 4's having staggered holes bored to allow reinforcement to project from the finished slab on the edges.

Three-eighths-inch steel rods were placed 16″ o. c. each way, also ¾″ rods projecting 1′ below for anchorage into pilasters. In addition to the rods, the sections were further reinforced with wire fencing, No. 9 wire, 3″ x 6″ mesh, electric weld.

The molds were filled with 3¼″ of concrete mixed in the proportions of 1 part cement, 2 parts clean sand, 2 parts clean rock, through 1″ mesh screen, and the top surface was finished with a 1:1 mixture, colored with raw sienna powder, after which small yellow pebbles were lightly tamped into the fresh top.

The slabs for each side wall were cast and raised before the end walls were molded.

A portable derrick of 4,000 lbs. capacity was used in handling the sections, from which, when slightly raised, the loose bottom form lumber was removed, leaving the furring securely fastened to the inside surface by virtue of the nailheads embedded into the concrete.

The slabs were placed upon the foundation spaced about 10″ apart, plumbed and braced.

Interchangeable pilaster forms were fastened inside and out and held in place by means of double wires and wedges. After pilasters were poured (anchor being placed in each pilaster at top to fasten rafter plate) the wires were cut and the forms removed and used again on the other walls.

The inside was ready for the lathers without further work. The large front door opening, with transom and side lights, had no slab—simply a pilaster on each side and a girder above. The finished curtain wall is 6½″ thick, outside to outside.

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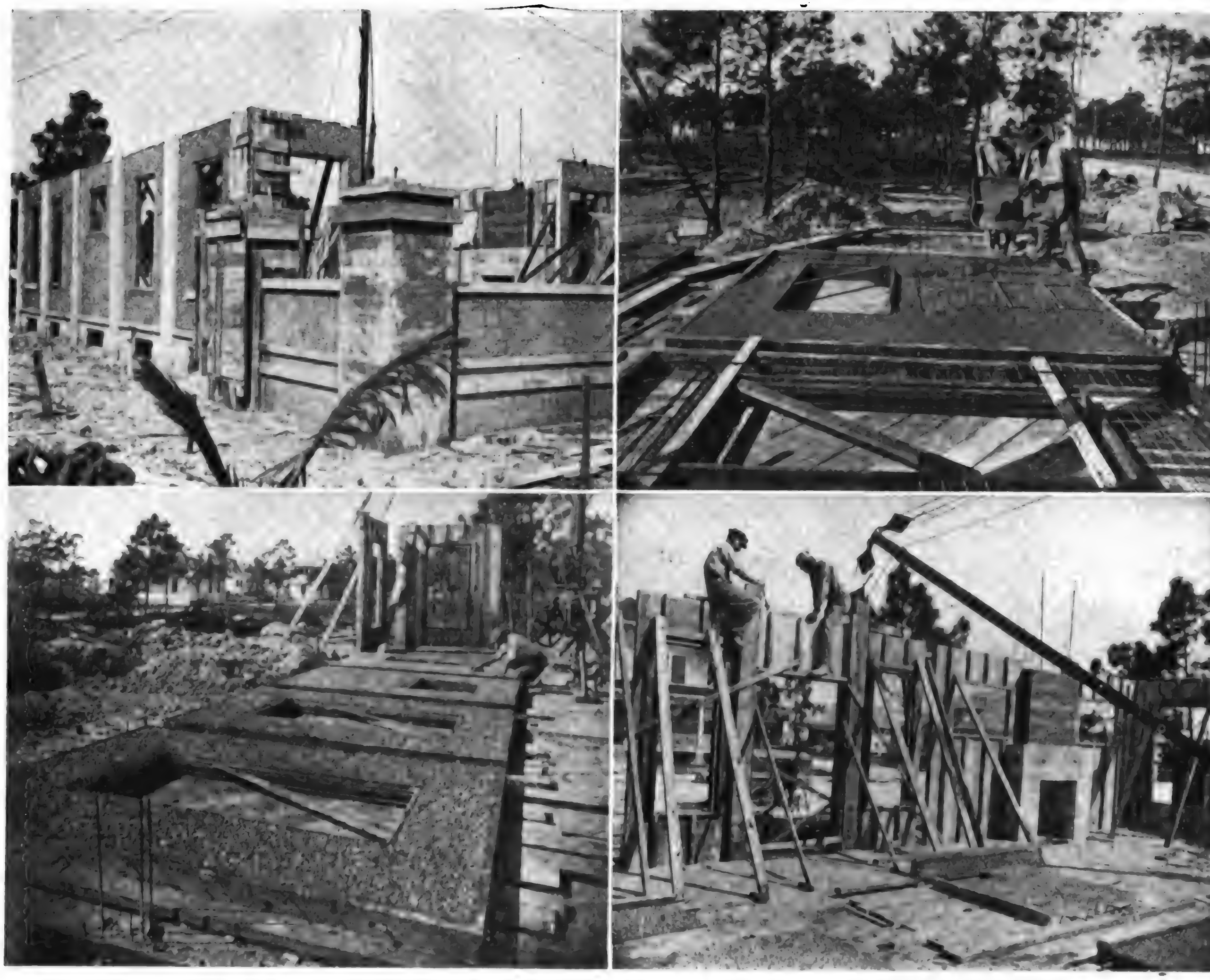
[1]Concrete, June, 1917.



FIGS. 2-5—PROGRESS VIEWS IN THE ERECTION OF A UNIT-BUILT BUNGALOW BY DAVIS SYSTEM

Fig. 2 shows a section being cast with casement window frame in place, also in the foreground a section containing a double-hung window. All the reinforcement had not been placed in this form.

Fig. 3 shows the south wall being cast and finished; all but one section was made in a part of one day, by one mechanic and two laborers.

Fig. 4 shows the pilaster forms being wired in position for pouring—note that chimney holds two sections in place.

Fig. 5 shows a view of the south wall after the pilaster forms were removed. The large posts in the foreground also hold the porch wall sections firmly in place, the slabs being embedded in the posts about 3". These porch wall slabs were cast flat, 4" thick, with 8" coping.

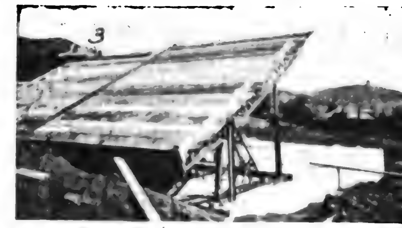
The completed building, showing artistic effect of walls, divided into sections or panels, and treated with color effects, is shown in Fig. 1. The pilasters and posts are tinted cream color, the walls buff.

The system the inventor had in mind was to mold the curtain wall sections at a central point, provided with a large concrete floor, modern mixing plant, and overhead traveling crane. In this way, the sections could be molded and placed upon the building site at a cost not exceeding 13 cts. to 17 cts. per sq. ft. The hauling could be easily done on a truck bed, designed for handling such material; the slabs would be lifted off the floor by means of the overlaid crane installed in the plant.

To be properly equipped, a small traveling jib-crane to operate on portable track in sections will be required for removing the slabs from the truck and placing them on the foundation (estimated cost of crane $1,200).

Points urged by the inventor are: There would be absolutely no change in the designs or construction of a large structure, of the skyscraper class, necessary so far as the engineering problem or the skeleton of the building is concerned; the only difference is an improvement in the old system of filling in with materials which only add weight and strain, instead of strengthening the skeleton. It certainly forms a rigid support and brace for the pilasters and girders, whereas when curtain walls of small units are built in afterwards, no strength is gained; on the other hand, more strain is added. With the slab system no outside scaffolding is required, except perhaps small swinging scaffolds for finishing the pilasters. One main process does not hold back the other subdivisions of the work, as with the old idea of filling in the curtain walls afterwards; a contractor properly equipped could place the slabs and pilaster forms and cast the entire walls of a medium-sized store building in one day, and the finishing could begin at once, as soon as the second floor girder had set, or even before.

The possibilities for ornamentation at a minimum cost are unlimited; while the slabs are being cast the surfaces can be finished in any desired color, style or finish at little extra expense; cast concrete or other ornaments could be easily fastened in place, or at least anchors provided for them; the surface troweled smooth, floated, veneered with tile, marble, mosaic, or any other ornamental material. Thin tiles made in imitation of pressed brick could be easily cemented to the outside surface, while the slab is being cast.



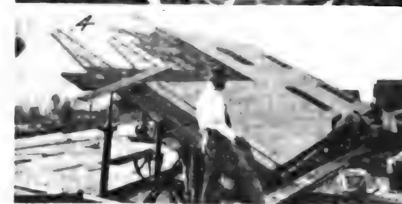


Fig. 1—Concrete House with Pre-cast Walls, at Hollywood, Cal.

Fig. 2—Interior, Showing Concrete and Tile Fireplace

Note the sanitary finish of door and window openings and absence of wood trim.

Fig. 3—Form Ready for Concrete

Fig. 4—Ready to Raise Wall Section

Fig. 5—Three Stages of Construction

Fig. 6—Walls Ready for Plaster

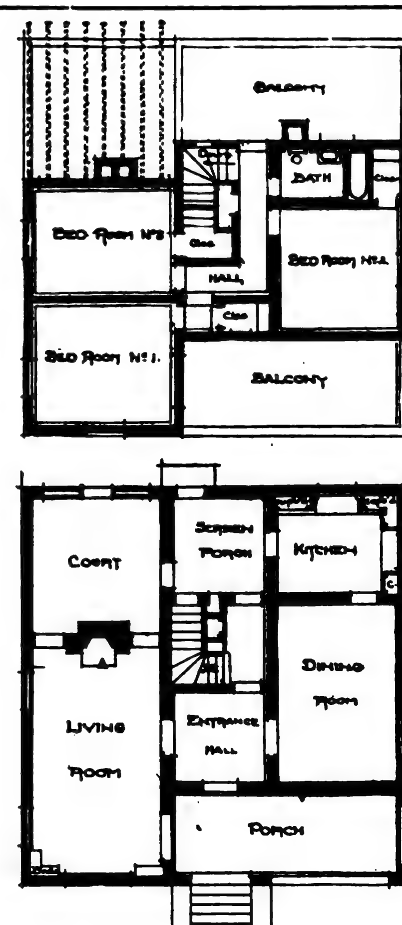
A California House With Pre-Cast Walls[1]

Early in the history of concrete construction, Colonel Aiken, U. S. Army, devised a system of casting the walls of buildings in a horizontal position and raising them with special equipment. Numerous buildings were erected, notably at army posts, but the system was not widely used. In the construction of a concrete house at Hollywood, Cal., the walls were pre-cast in a horizontal position and raised by motor-driven jacks. The house was designed by Irving J. Gill and erected under his supervision.

After the foundation for the house had set, the floor slab was laid and on this jacks for the erection of the walls were placed, which are well shown by Figs. 3 and 7. Twelve feet of floor space from the wall to be erected was required in which to place the jacks, on which tilting tables, built of 2″ x 6″ rough plank were laid over steel walking beams. The number of jacks used and the spacing of them depended on the weight and size of the wall to be supported.

Door and window openings were laid out, the metal jambs set in place and the remaining surface of the wall form covered with hollow tile spaced for reinforced concrete beams to give proper stiffness; twisted steel rods were then placed vertically and horizontally, and the wall was ready to be poured. Concrete was wheeled up an incline, dumped, leveled off and allowed to set.

Fig. 10—First and Second Floor Plans



[1]From Concrete, May, 1918, p. 197.

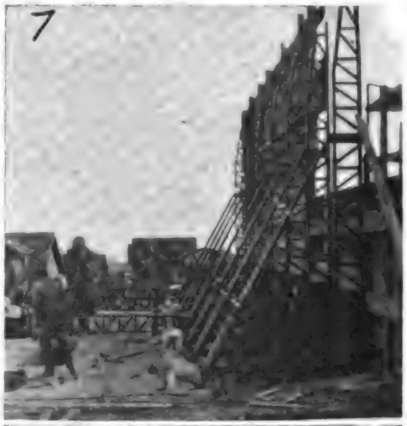


Fig. 7—Raising Equipment

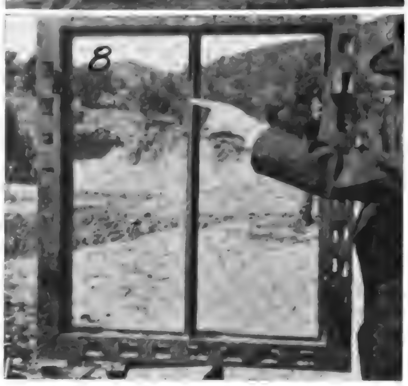


Fig. 8—Metal Window Frame

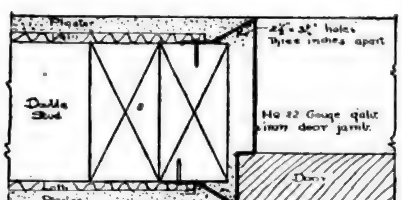


Fig. 9—Detail of Metal Door Frame

The upper surface (the outside of the wall) was finished in its tilted position before being raised.

The power for erection was obtained from a 5 h. p. gasoline engine and transmitted to the jacks by a shaft through their pedestals. A worm gear mechanism extended all jacks at exactly the same rate.

From ½ hour to 2 hours was required to raise each wall, the time depending on the weight, shape and position of the wall.

Horizontal rods left projecting from the ends of the walls were bound together after two adjacent walls had been raised to an upright position. A form 2′ wide was built up the entire height of the wall, and into this concrete was poured, producing a concrete and hollow tile steel reinforced with twisted steel bars.

Construction Details

Roof joists are held in place by anchors, for which provision had been made in the concrete wall, and 1″ by 6″ sheathing covered by a gravel composition was used for the roofing. Interior partitions are of metal lath on wood studding, and the rough concrete slab has been covered by a finish coat reinforced with wire cloth.

Special metal door and window frames were used, manufactured from No. 22 galvanized iron bent to shape and provided with perforated flanges, through which the concrete forms a key. The plastering finishes flush to the corners of the frames, which act as a corner bead for both exterior and interior wall surfaces. Each side of the frame is bent from one piece of metal so there is no danger from cracks.

Sanitation and fireproofing are the features of the finish, as well as the structural details. There are no moldings or panels on the doors, simply plain slab surfaces easily cleaned or dusted, while the absence of baseboards, ceiling, plate rails, door and window casings and picture molding makes the house as nearly dirt proof as is possible.

The experience gained in the construction indicates that it has possibilities for economy that will recommend its more extended use.

Walls Lined With Hollow Tile[1]

By C. R. Knapp

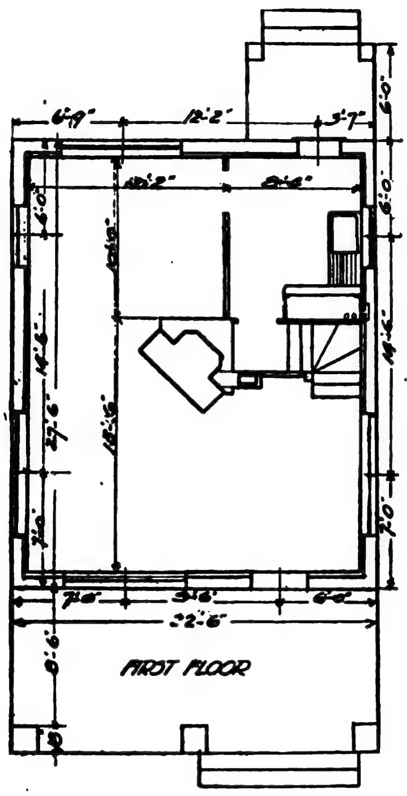
In building concrete houses, where hollow walls are used, it has been the general practice to use a movable core system, the core being moved up as fast as the concrete gets to the top of the core. I have used this method on a number of buildings but gave it up to use a 3″ partition tile placed in the center of the wall, making two 4″ concrete walls with this 3″ tile between. This way of producing a hollow wall has a great many advantages over the "pull-a-core" system besides showing a decrease in the cost. The saving of time more than overbalances the cost of the tile.

Fig. 1—House Built of Concrete by New Method

In building the concrete house here illustrated, I believe that I have made a still further advance in the hollow wall methods. The results fully bear me out in this belief. In this case instead of placing my hollow partition tile in the center of the wall I have used it

[1]From Concrete, Jan., 1915, p. 22.

Fig. 2—First Floor Plan, Albany House



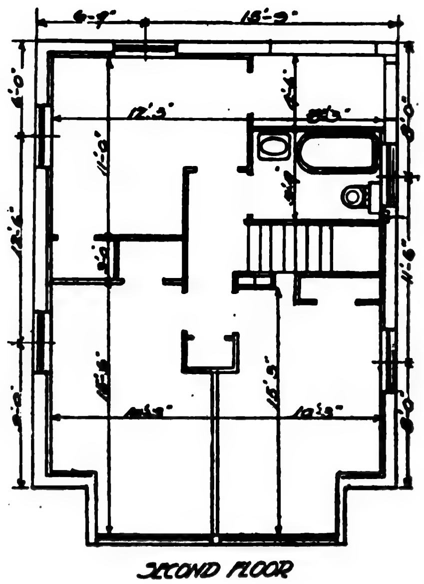
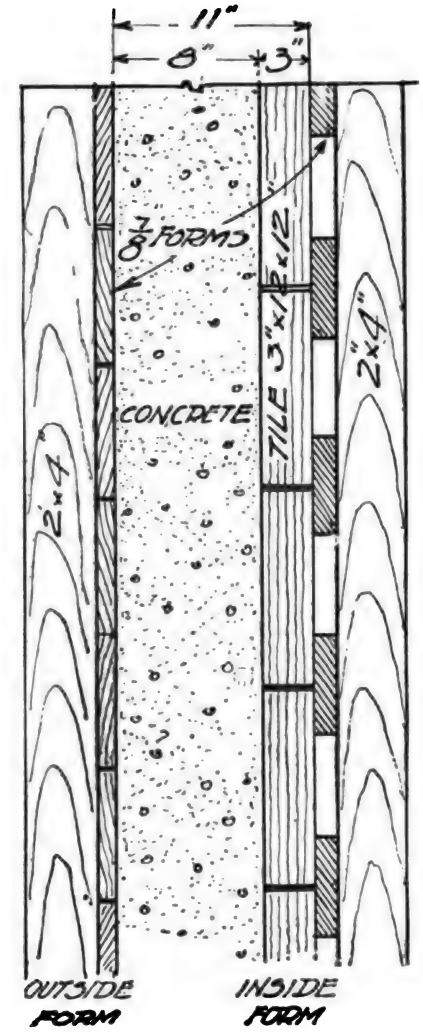


Fig. 3—Second Floor Plan

Fig. 4—Detail (at right) Showing Method of Wall Construction



for my inside form. This brings my two 4" concrete walls together, making an 8" solid wall and saving one line of steel reinforcement. The tile are held in place by a board or strip in front of the 2 x 4 uprights which are put in at regular spacing to match the 2 x 4's of the front forms. Reference to the drawing will show that the boards or strips that hold the tile in place come only at the joints where the tile open. There is in this method a great saving because it saves building the inside forms and leaves only one side of the concrete wall to look after. The tile are more easily handled and can be kept in place better than when used in the center of the wall, and the air space is just as effective. In the finish of the inside wall the wall plaster is put directly on the tile, to which it adheres firmly.

The finish of the outer wall is bush-hammered at a cost of approximately 3 cts. per sq. ft. The roof is of red asbestos shingles, thus giving a touch of color.

The finish of the woodwork inside is mission. The finish of the woodwork outside is painted white.

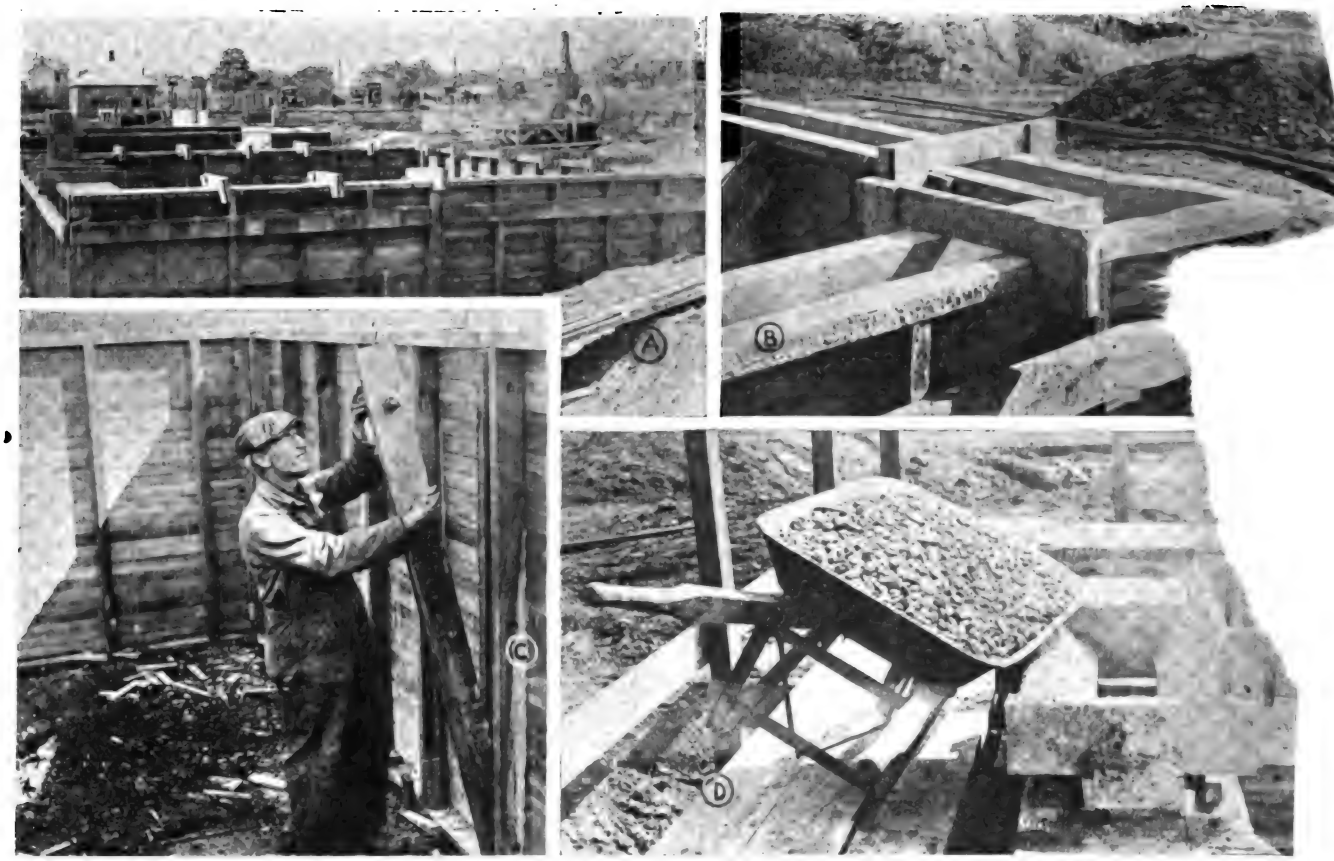


Fig. 1—Interesting Concrete Foundation Work for Frame Houses at Phillipsburg

Unit Forms Speed Up House Foundations[1]

As a part of the housing project of the Phillipsburg Development Corp., Phillipsburg, N. J., involving a large number of concrete houses by the Ingersoll system (see elsewhere in this volume), 25 frame houses were erected on concrete foundations.

An interesting feature of the work was in connection with the forms for these foundations. Cellars are 20′ 2″ by 24′ 2″ by 6′ 6″, with an 8″ concrete wall. The entire basement form work is in eight panels, two for each side for the inside forms and an equal number outside. A detail shows the way the panels are keyed at the corners and shows how they are bolted. This is also illustrated in Fig. 1, A, B, C, and D. In C, in this group of illustrations, a 2″ x 6″ timber is being shoved into place, and this, when bolted, holds the forms securely and tightens them up at the corners. With this system it takes four men 10 to 11 hours to strip and set up the form work. These four men are carpenters, at 60 cts. per hour—cheaper than carpenters with helpers. These men have a little help when the large panels are being carried from one job to another. The runways shown in the same figure at D, are set up by two men in two hours and stripped in 40 minutes. The concrete is placed from wheelbarrows in from seven to eight hours, and at one setting of the mixer, the work requiring 16½ to 17 cu. yds. The mix is 1:3:5 concrete, of cement, sand and cinders. The wooden forms for these foundations have required no repairs and are giving splendid surfaces, special care being taken in

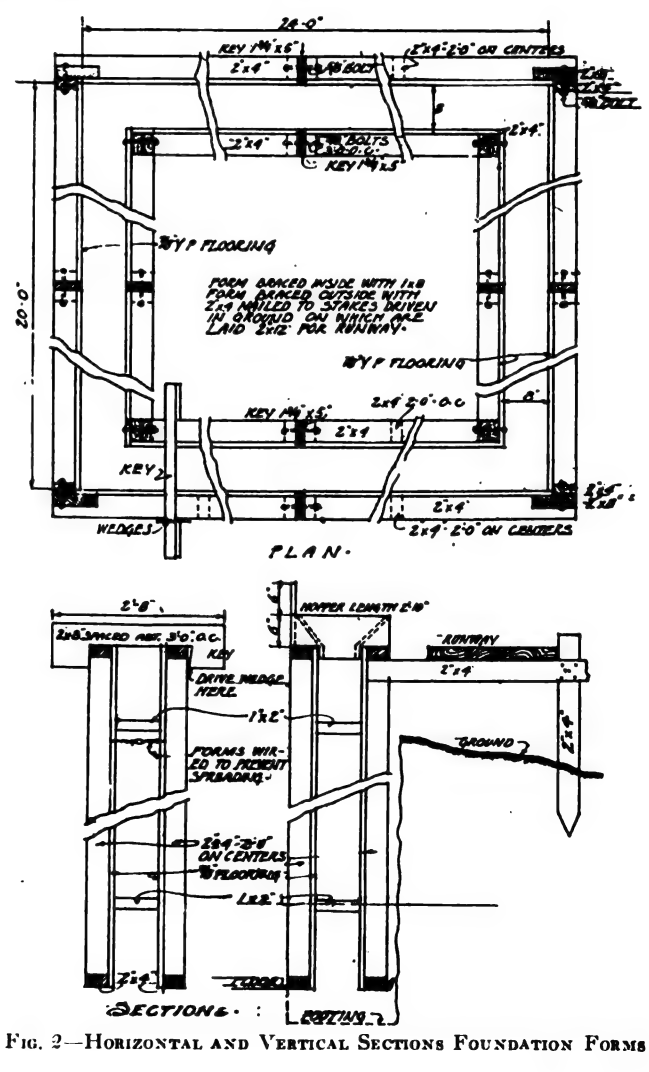


Fig. 2—Horizontal and Vertical Sections Foundation Forms

[1]From Concrete, Feb., 1919, p. 62.

spading the concrete to get a finished appearance, so that no surface treatment is required. The form work was developed by Superintendent Henderson, who also devised the hopper, shown at D in the illustration. By means of this hopper, resting over the space between the forms, it has been possible to place the concrete from wheelbarrows without ever losing a single barrow load.

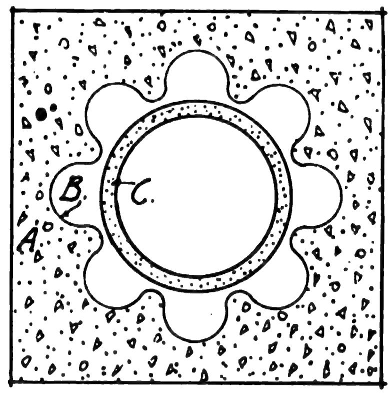


Fig. 3—Cross Section of Chimney

In these frame houses a concrete chimney is being used, made up in blocks 10″ high in two parts. The outside, or block, has a scalloped interior cell, roughly indicated by the accompanying detail. Inside this is placed a concrete pipe flue lining, with tongue and groove joints. Blocks are made twice as large as they are brought through the roof, to give a more impressive architectural effect and a special cap, also made of concrete, gives a neat finish. The chimney itself is stuccoed a light color and the caps are painted black. The chimney block and caps are made by George Godown, Phillipsburg.

All the houses in the Phillipsburg development will be served by Sanisep septic tanks, manufactured by the Cement Products Co., Wilmington, S. C., with one tank for four houses.

Home-Made Wall Forms[1]

It has often been found, when the need for equipment to accomplish a certain object has arisen, that two or more men working independently would hit upon the same solution of the problem. This is shown in the development of a number of years' experimenting by F. J. Beaty. Chowchilla, Cal., and working independently by August Matzke, Winona, Minn. Each has erected a number of interesting buildings with his system of forms and finds it a very successful method. Fig. 1 shows the construction. Mr. Beatty uses forms made up of uniform thickness and width. At frequent intervals 2″ x 12″ plank surfaced on both sides and brought to small pieces of lumber thickness and width. At frequent intervals small pieces of lumber about 1″ x 2″, called clips, are nailed to the planks, projecting about 1½″. Mr. Matzke uses shiplap with 2″ x 2″ cleats.

The method of erection is as follows: The line of forms is run around the building and wires are twisted around the projecting ends of the clips. Spacers are inserted and the wires twisted tight. A second section is then placed, the ends of the plank sections being brought opposite a clip, as shown in Fig. 1. These two courses of plank forms are filled and the concrete is allowed to set from six hours to ten hours; the lower forms are then removed by cutting the wires and turning them up so as to support the upper line of plank. The lower planks are then placed above the section on the wall, and the work continued. It is stated that enough forms to go around the building twice are usually sufficient to take care of the work. Forms are oiled with crude petroleum before being used, and it is stated that they are in good condition after erecting several buildings.

Woven wire mesh is used as a reinforcement, and is placed as shown in Fig. 2.

The window frames are made of 2″ x 6″ lumber, placed in the wall as the work progresses, as shown in

[1] Concrete, March, 1916.

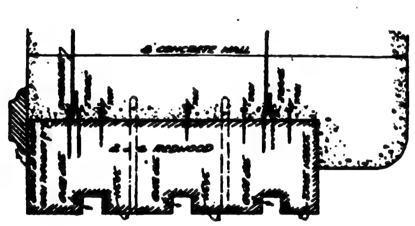


Fig. 1—Window Frame Detail

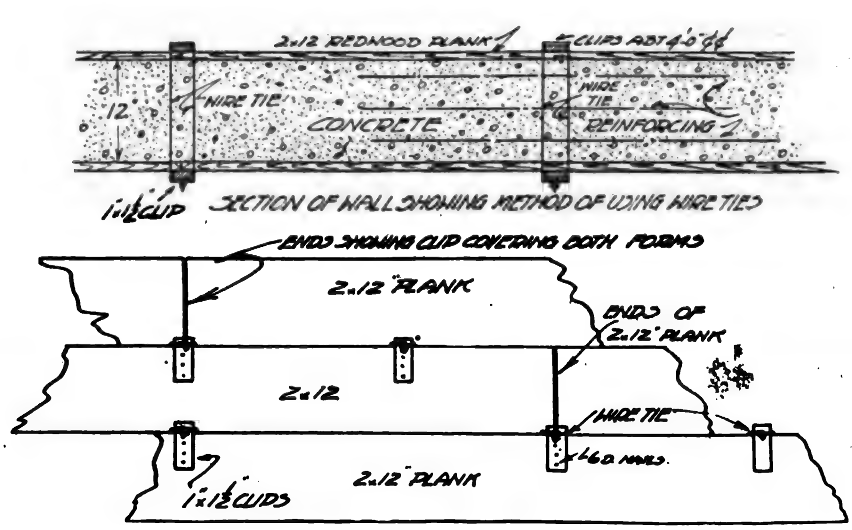


Fig. 2 (at Right)—Detail of Formwork, Showing Clips and Reinforcing

Fig. 1, and fastened to the concrete by means of nails driven into the back of the frames. No wood sill is used, the sash fitting directly on the concrete sill. The joint is covered by an astragal molding, and the sash secured by beads in the grooves as shown. Pullman spring sash balances take the place of weights, making a distinct saving in cost, due to the extremely low-cost frame.

Hollow Wall Bungalow Built With Home-Made Machine[1]

By Henry L. Wilson
Architect, Los Angeles, Cal.

The accompanying illustration shows a nine-room bungalow recently designed and built by the writer for Rev. Seth O. Rees, in Pasadena, Cal.

The bungalow is constructed with hollow concrete walls. The forms are my own idea and have proved a success both in durability and low cost. Two 3″ concrete walls, with a 2″ air space between, form the wall section. The walls are bonded by metal studs made from 24 galvanized sheet metal cut in strips 6″ wide by 9′ long. Both edges of the studs were turned back with a ½″ circle, which stiffens the studs and forms a clinch in the concrete walls. The foundation walls were put in in the usual way, a solid 10″ wall to floor joists; the metal studs were then set up edgeways across the wall on 18″ centers and were held in line by a temporary plate at the top. The hollow walls were then started on the foundation.

Forms

The forms used consisted of two pieces of ordinary 2 x 10 lumber 6′ long, two iron clamps made of 1¾″ channel iron bent U-shaped to fit over the outside of the form boards and to hold them in place while the concrete was being put in. Near each end of the boards a small steel pin was driven through near the bottom edge projecting about 2″ to catch on top of the wall and to hold the forms up in place. The cores were made of wood 2″ thick, 10″ deep and 18″ long, with two large screw-eyes in the top by which to pull them out. These cores were placed between the metal studs; the 2 x 10's were placed at each side, the clamps placed over them; they were then filled with semi-wet concrete, well tamped, when the cores were pulled, the clamps removed and the boards moved forward their length, and set up and refilled, and so on around the house to the starting point. By that time the concrete had set sufficiently to permit another course to be placed, and so on until the walls were finished. A set of these forms cost less than $5.00.

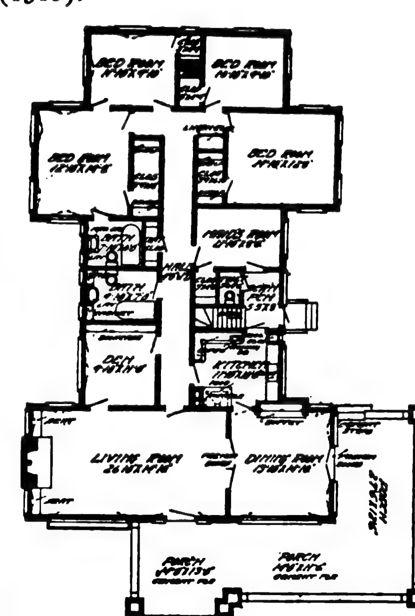
General Features

After the rough concrete walls were up they were finished with Atlas white cement and silica sand; the insides of the walls are plastered directly on the concrete. Inside partitions may be built in the same manner, but in this bungalow 2 x 4 studs were used, lathed and plastered in the usual way.

The bungalow contains nine rooms and basement; living room, dining room and den; it has panel wainscoting and beamed ceilings, oak trim and oak floors. Living room has a tile mantel with book cases on either side. There is a large buffet in the dining room; the kitchen is fully equipped with all modern conveniences. A concrete garage large enough to accommodate two cars was also built, and the house and garage were constructed for about $5,000 (1915).

[1]From Concrete, Jan., 1916, p. 30.

Bungalow in the California Mountains



10 Fireproof Houses of Field and Pre-Cast Concrete[1]

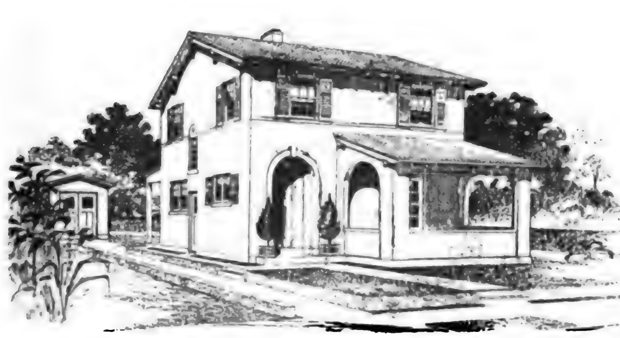
STAFF ARTICLE

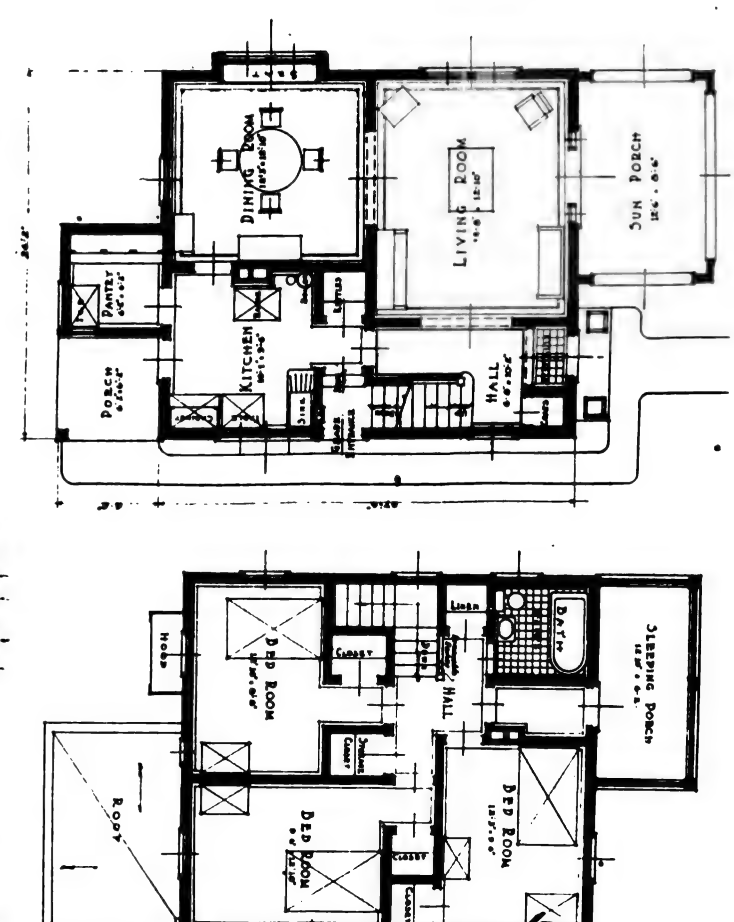
Ten 6-room fireproof dwellings are being completed at Lansford, Pa., for the Lehigh Coal & Navigation Co., by the Simpsoncraft system of concrete construction. Work is being done on a lump contract amounting to $30,000—$3,000 per house.

The houses in various stages of construction are shown in accompanying illustrations, the general character of the group being indicated in Fig. 1. There are eight separate structures, two of them double houses.

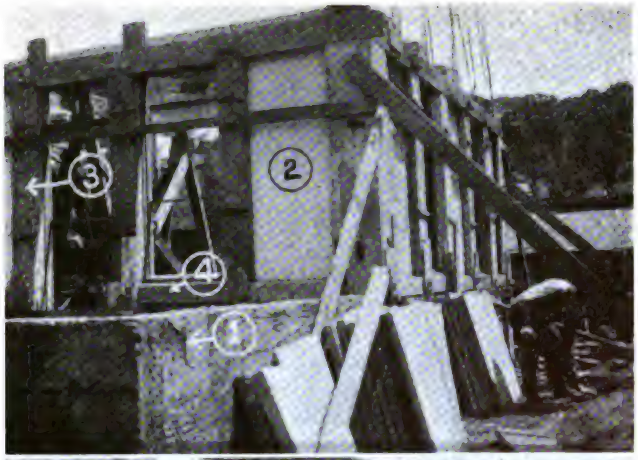
The Simpsoncraft system, worked out by John T. Simpson, Newark, N. J., involves the use of precast reinforced units, most of them light and readily handled, set up on a monolithic foundation wall and tied together by other reinforced structural members which are cast in place. An inspection of the ten-house job at Lansford, which has not progressed rapidly, suggests to the writer that the system is extremely elastic in design and far more simple in actual fabrication and erection than might appear from the inventor's details. Its successful application to extensive housing enterprises (it would not, it seems, be economical for single dwellings or extremely small groups) depends, like a good many other developments, which have gone slowly in the concrete field, upon the thorough training of two or three men in the details of the system and the thorough organization of a crew. A good carpenter and a good cement finisher under a competent superintendent, with an organized crew of average intelligence, should be able to standardize operations in precasting, erecting and field pouring and finishing so as to give a fireproof and weatherproof construction at low cost. Most of the work done with the system has been on a small scale and insufficient in extent to develop a suitable organization for economical results. The work on the ten houses at Lansford offered an opportunity, and while the contract is being put through at a price of $3,000 per house, the contractor, due perhaps to lack of organization under

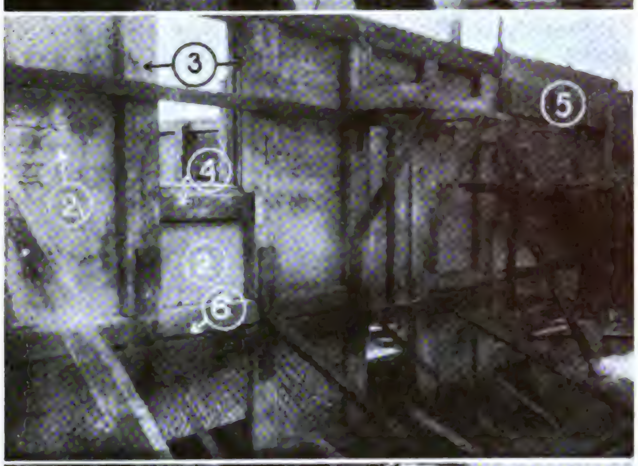
[1]CONCRETE, August, 1918.





FLOOR PLANS OF A SIX-ROOM HOUSE VERY SIMILAR TO HOUSES AT LANSFORD—FOR THIS PLAN MR. SIMPSON SUGGESTS VARIOUS TREATMENTS OF ELEVATION





Figs. 2, 3 and 4 (Top to Bottom)—Details of Simpsoncraft Construction

Precast slabs and sills in place on foundation and forms set up and braced ready for pouring studs. At bottom, floor beams in place. (1) Monolithic foundation; (2) Precast slabs; (3) Forms in place for studs; (4) Precast door sill; (5) Forms in place for field cast porch beam; (6) Precast sill or belt course; (7) Lower flange of floor beam to support slabs for beamed ceiling, if desired.

trying labor conditions, has not taken the fullest advantage of an opportunity.

Walls and floors are constructed with thin precast slabs in convenient dimensions, poured and finished on pallet forms in a shop on the job. These are reinforced with Clinton welded wire fabric, which projects at the edges for tying up with the field cast structural members. They are slid off the pallets and stood on end 24 hours after finishing. The exposed surface of wall slabs may be finished as desired—troweled, floated, brushed or scratched for stucco application. Horizontal belt courses and sills, suitably reinforced and having projecting rods to tie into field cast members, are also shop-made in molds providing slots which admit the thin

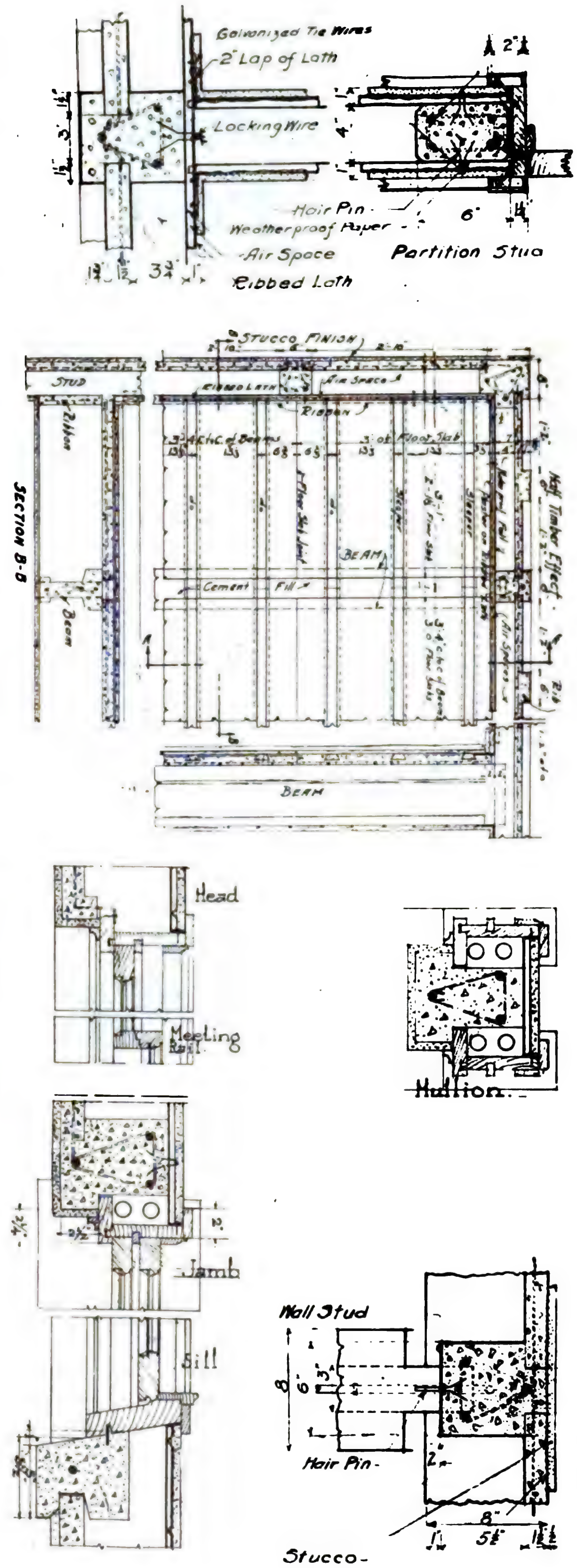


Fig. 5—Details of Simpsoncraft Construction

At the top are shown details of wall stud for paneled wall and a partition stud. Below, typical structural plan and sections. Bottom left, window details and mullion at right. Lower right corner, detail of wall stud for flush unpaneled wall.

wall slabs. Combination risers and treads for stairs are also shop-made to be tied together by field cast strings. Balustrades are either shop cast, or field cast with strings, as desired. I-beams for floors are the heaviest shop-cast members. For the first floor above

FIG. 6—DOUBLE HOUSE WITH 6 ROOMS EACH SIDE, ERECTED BY SIMPSONCRAFT SYSTEM

FIG. 7—A SINGLE HOUSE OF 6 ROOMS, PART OF THE GROUP AT LANSFORD

the monolithic foundation, floor I-beams are spaced on horses set on shims at floor height. For a paneled ceiling precast slabs are placed so as to rest on the upper edges of the lower I-beam flanges. For flush, plastered ceilings, wire loops in the bottom of the beams support metal fabric. For the floor, the thin precast slabs rest on the I-beams and the joints covered by a concrete floor 1″ thick, finished in place. For a wood floor finish wire ties cast into the floor slabs permit securing the sleepers to which the finish is nailed.

Walls are built up with a horizontal, precast, slotted belt course at story heights, or at other levels to suit design, with thin slabs between, the actual structure of the work depending on field cast studs or small pilasters, poured in place, which join the slabs, belt courses and studs in a stiff construction.

These vertical members may be cast with an exterior projection to give a paneled effect or flush outside where stucco is to be applied on a plain field. The interior projection of the stud provides the tubular wall, furring and lathing being applied inside. These field-cast studs, in which the reinforcing rods are continuous for the height of the house above the first floor level, support the beams of the upper floors, the projecting rods of the beams locking into the vertical rods of studs when the field casting is done.

In actual erection slabs are set up at wall corners and horizontal strings thoroughly braced for alignment. If the walls are flush outside, a plank covers the vertical joint between slabs and provides the outside form of the stud, while three form boards with rounded fillets at corners provide the interior form. The two sides are wired through, twisted and wedged. If paneled outside, a portion of the stud thickness is provided outside by a shallow channel mold.

The system is architecturally elastic because the vertical studs may be spaced as required to meet structural demands and be hid in the finished work, while in paneled effects, as in the upper stories of the houses under construction at Lansford, vertical ribs may be merely false studs cast on the slabs in the shop with such spacing as is desired.

Building Low Cost Houses With Unit Forms and Continuous Conveyor[1]

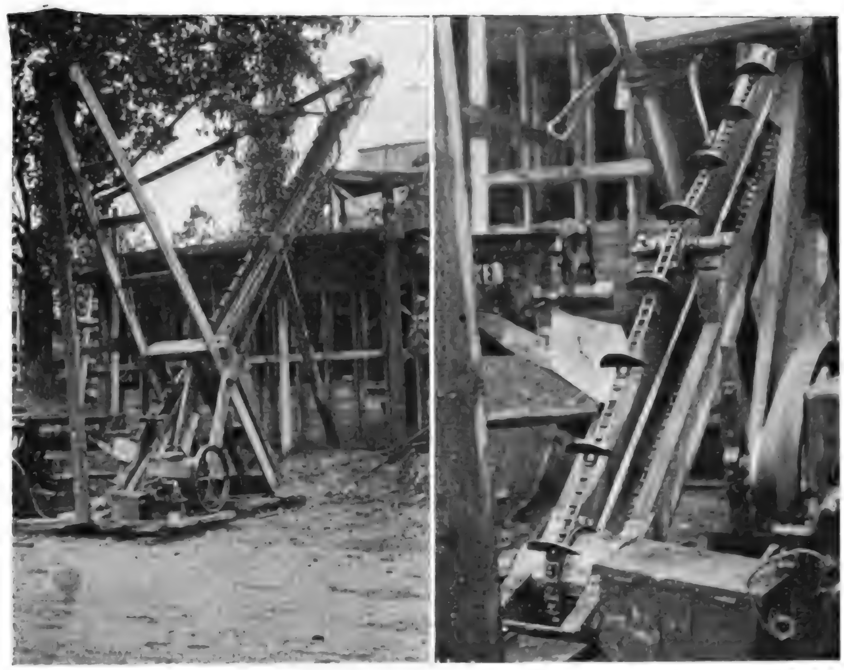
Low costs are being obtained by the Humphrey Co., Cleveland, in the construction of small concrete cottages at Euclid Beach Park, using the Hydraulic system of forms, consisting of plates and ribs and for placing the concrete a continuous mixer, with elevating equipment designed by D. S. Humphrey. The work has been in charge of P. M. Killaly, engineer for the Humphrey Co. The initial undertaking in this construction of concrete cottages was described in CONCRETE more than a year ago.[2] In the first work a system of wood forms was used which, it was found, required too much time in erecting. Further work has been waiting in the meantime for the perfection of the commercial system of forms, which is now in use and which probably will be used in the construction of many other cottages if the work continues as satisfactorily as it is now believed it will.

The two cottages recently built are 35′ x 22′ outside dimensions, and 9′ high from floor to ceiling. They are for summer campers and will replace tents which the Humphrey Co. has rented for various short periods of time in the summer at Euclid Beach. Canvas tents were found very expensive, as they lasted in good condition only two or three seasons, and the construction of concrete cottages along some rather original lines was undertaken with the idea of finding something which would be more economical in the long run. The cottages have three rooms, including a fairly large living room, kitchen and bath room, with hot and cold water and a porch extending around three sides of the house, which is to be screened off and used probably for the most part for sleeping accommodations. The plan dimensions include the porch. No attempt has been made to build these houses for all-year-round occupancy.

The walls are 4″ thick, the slabs for the floor and the roof are 5″ thick. The roof is surmounted by a low parapet all around, and the roof slab covered over with 6″ or 8″ of soil, on which grass will be grown. The idea of this soil and sod covering is to prevent the rooms below from becoming too hot under the summer sun.

[1]CONCRETE, January, 1916.
[2]November, 1914.

The floors are laid directly on the ground, being constructed first, and the forms set up on top of them. The soil is well drained and sandy along the water front, and it is believed that for the purposes intended this method of construction will prove entirely satisfactory. Each of these cottages as now built requires 54 cu. yds. of concrete. Lake gravel is used, screened through a 1⅛″ screen, with a mixture of cement in the proportion of 1 part cement to about 3½ parts or 4 parts of the gravel. The gravel costs nothing except hauling, and this cost for each cottage does not exceed $20. One house requires 77 bbls. of portland cement, at a total cost of $99. It took eight men a little over 4 days to erect the forms, but the foreman of the job is confident that when these forms are entirely perfected, as they had not been in the construction of these houses, it will be possible, through greater ease in fitting the plates and the ribs, to set up the forms in about half the time that it required on the first two cottages. This would bring the cost of setting up the forms to $34.40, the men being paid at the rate of 24 cts. per hour, with the exception of two men, who were paid 25 cts. per hour. No skilled labor was required. The continuous mixer, driven by a Novo engine, is used and the concrete is mixed very wet. It falls direct from the mixer trough into the elevator.



FIGS. 1 AND 2 — GENERAL AND DETAIL VIEWS OF ELEVATING EQUIPMENT

The elevator consists merely of paddles on a chain operating in a trough. This chain is run at high speed, so that whatever concrete slips through one paddle is picked up by the next one. The rapidity of operation makes it possible to convey even water from the bottom of the conveyor to the top of the house. The elevator is driven by a 3 h. p. engine. The concrete empties into a spout at the top and this is pivoted so that it can be moved around to cover the entire area, making pouring continuous. With this equipment and with 7 men on the job a house complete, except for the floor, which was previously made, and for the parapet above the roof, was poured in 3 hours. The nature of the conveying apparatus serves as a continuation of the mixing process, so that when the concrete leaves the end of the conveyor it is in excellent condition, and, so far as can be noted, without any separation of the fine from the coarse material. The resulting concrete surfaces are good and without pockets, and almost free from pinholes.

With the new system of forms it is possible in fairly good weather to remove the plates 24 hours after pouring. The ribs which hold the plates remain in place as long as may be necessary to support the walls. The forms can be stripped by eight men in one day and in that time given all the cleaning that is required. The surfaces are very smooth, and with reasonable care the forms are expected to last a long time with but small depreciation.

In the construction of the cottages an unusually large amount of steel was required in order to conform to the building ordinance of Cleveland, and for this job amounted to 5,032 lbs. at a cost of $105, cut to size. The floor slab has ⅝″ and ⅜″ round rods 12″ o. c., the walls ½″ rods 12″ and 15″ o. c. Trussed rods were used over all wall openings, ⅝″ rods in all pilasters and columns, and ¾″ rods were placed in fan shape in the L of the porch. The earlier cottages, built more than a year ago with far less steel, have been entirely satisfactory.

Mr. Killaly took the concrete just as it came from the end of the conveyor and made three 6″ cubes, which showed an average strength at 28 days of 1,779 lbs. per sq. in.

One of the cottages was given a crandalled finish. This work was done 7 weeks after the house was poured, and one man's time was required for 5 days to do it. Pilasters and corner columns and strips around windows and doors were left smooth for trim. One cottage had approximately 1,057 sq. ft. of surface to be finished, and the total cost was $10.75, or approximately 1 ct. per sq. ft. This cost, Mr. Killaly says, can be greatly reduced by doing the finishing soon after forms are removed. Mr. Killaly says that a price of $6.00 should cover this work if it is done at the right time.

Texas Houses Combine Precast and Monolithic Construction[1]

FIG. 1 — HOUSE BUILT BY TEXAS CONCRETE CONSTRUCTION CO., WITH PRECAST UNITS JOINED IN PLACE BY MONOLITHIC GIRDERS

A new and interesting construction with channel-shaped, precast concrete units, joined to form what is essentially a monolith, was devised by Stuart B. Moore and has been employed in the construction of houses by the Texas Concrete Construction Co. and the Turner Construction Co.—the work of the latter being on a group of 77 houses for the Humble Oil Co., in Texas.

The system here described was adopted first as an experiment on a few houses, and found so satisfactory that the first unit of 37 houses was completed; and then, the cost of the unit being so satisfactory, a second unit of 46 more houses was started.

This work was completed with a comparatively small gang of skilled mechanics, and a crew of Mexican laborers, who did most of the work, and in a very short time. Figs 2 and 3 show the reinforcement of the units as well as the manner of putting them together.

The construction method recommended is to dig a shallow trench (this, for a southern climate, in all cases the footing should be below the frost line) and pour the grooved footing. In this footing the units are stood up, as shown, reinforcing bars placed in the jaw at the top of the unit, which is then poured as a reinforced concrete beam.

The face of the units is finished with deep anchorages, so that the stucco can be applied. The entire wall is made to act as a monolith. These anchorages perform a two-fold function. First, they anchor the stucco coat to the units in such a manner that the diagonal and shearing stresses of a truss or beam are taken care of and secondly, they insure a perfect bond of the stucco coat to the wall.

The reader will no doubt inquire how speedily these units can be erected and what is the best method of doing so. The writer recommends first, placing the foundation, and then erecting a ribbon about seven feet above the wall outline of the building. The units are then merely stood up against this ribbon and the top jaw poured and the wall is complete.

Over the window openings, basket forms are dropped in between and hung on to the units and poured full. The forms can be used over and over again. Under the windows, short channels are used, and the window sill, which is generally poured in place, is used to lock them together.

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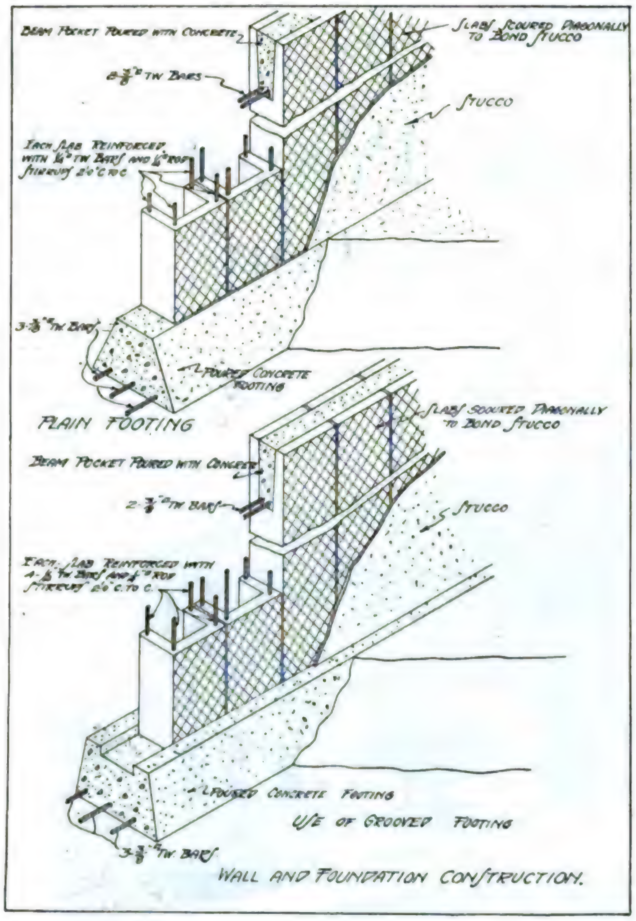
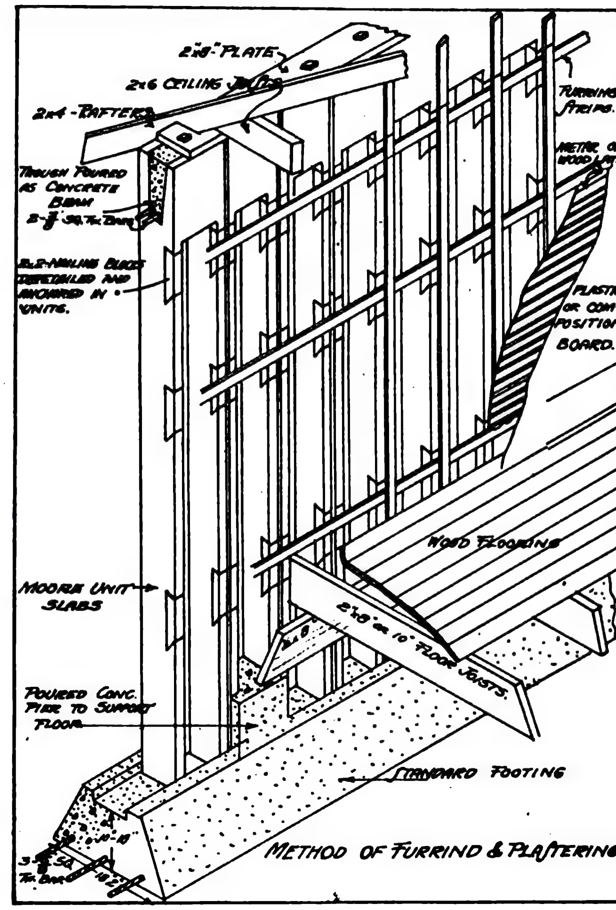
[1]Abstract of Article by Stuart B. Moore, CONCRETE, June, 1920.

BY F. E. SCHILLING
GENERAL SUPERINTENDENT, TURNER CONSTRUCTION CO.

The details in Fig. 10 show the construction of collapsible forms used in making concrete units. By using this method the channel blocks could be carried away from the platform on the day following the concreting, as they were picked up by means of the panel which acted as a bottom for the form. After carrying to the storage pile the panel and core were removed for further use. Enough forms were built so that blocks for one complete house could be concreted at one time, so allowing one day for concreting and the following day for stripping and replacing of forms, this installation allowed us to complete enough blocks for an entire house every two days. The forms were used over any number of times.





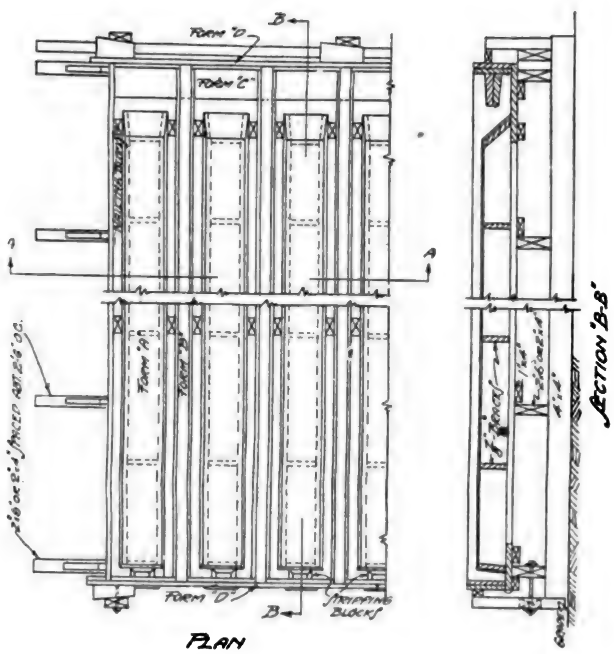
Figs. 2 and 3—Details of Moore Construction

Fig. 4 — Humble Oil Co. Houses Nearing Completion by Turner Construction Co.

Fig. 5 — Finished Row of Houses, with Stucco Finish

Four ¼" round rods were used as vertical reinforcement in each block, with stirrups about 2′ o. c. The concrete was a 1:2:4 mix, pea gravel not larger than ⅜" being used for the coarse aggregate. The method of grouping the forms continuously as shown allowed the dumping of concrete from wheelbarrows into the forms and a simple straight edging of the top surface to obtain the desired thickness of block. The scoring of the side to be stuccoed was accomplished by means of a saw-toothed piece of sheet metal raked over the surface as the mixture was getting its initial set.

Blocks were allowed at least ten days for hardening before erection was attempted. Ordinary labor was used for carting of blocks to the site of the house, and for the erection of the blocks, the only skilled labor needed for this part of the work being one or two mechanics to plumb the blocks after they were up-ended against the timber ribbon erected for this purpose. Carpenters were used to place forms for sills and lintels and after these and the tie beams were concreted the construction of the wood floors and roof followed along in similar manner to ordinary house construction.



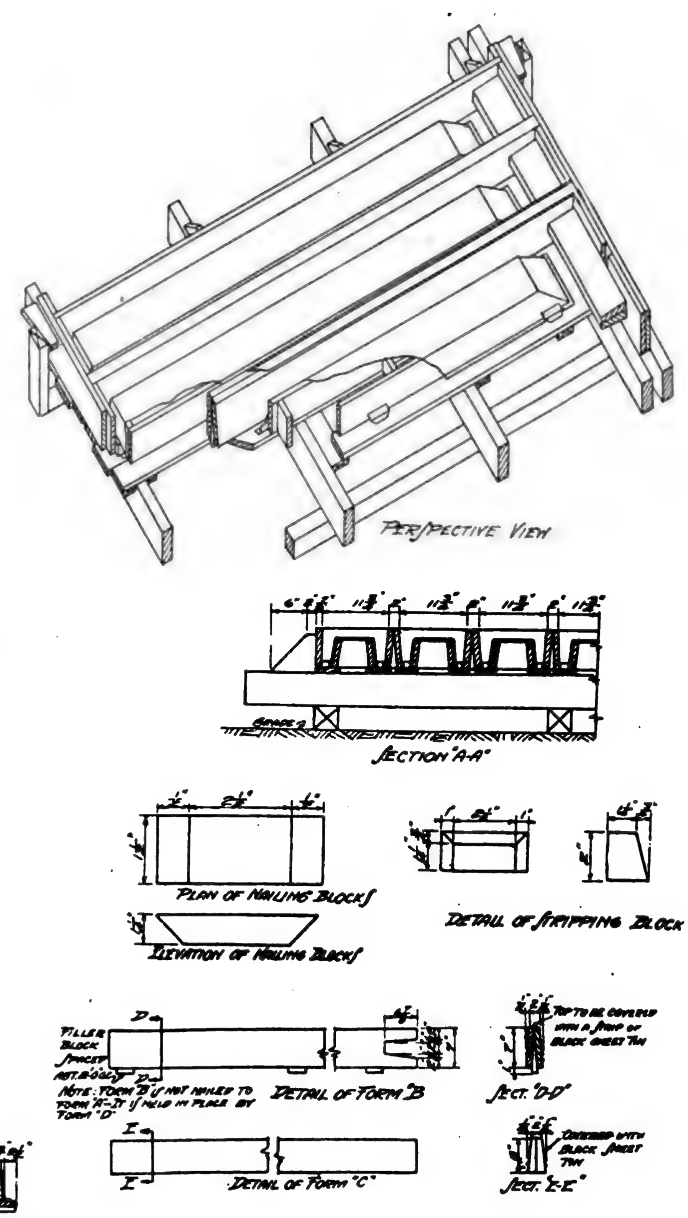
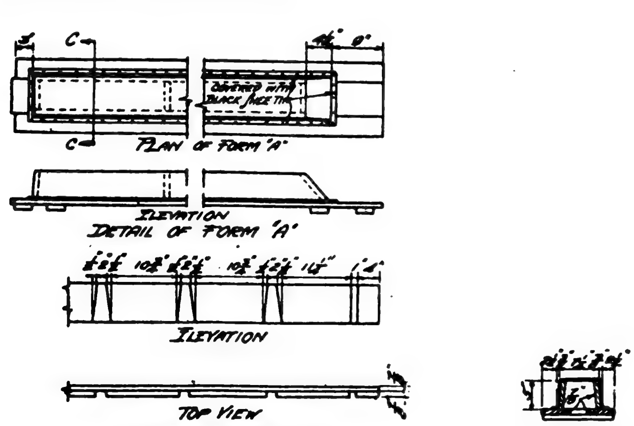


Fig. 10—Details of Forms Used by Turner Construction Co. on Humble Oil Co. Houses



Gunite Walls and Studs for Houses[1]

There is special interest in the development of types of construction which not only trend toward permanence and fire-proofness, but also employ a minimum of materials—the least bulk and dead weight. The gunite construction here described and illustrated is interesting along that line.

The Traylor-Dewey Contracting Co., Allentown, Pa., has been making studies and designs to embody the advantages of the more common types of construction and at the same time give, at less cost, additional advantages. The result, so far, consists in construction with the cement gun of walls and studs so as to minimize the use of skilled mechanics and the more costly materials and yet produce walls that are relatively fireproof, permanent and pleasing in appearance.

Cellar walls and foundations are of monolithic concrete by ordinary methods, and upon this foundation is first placed, flat, a 2″ x 6″ runner in such a position that the floor beams when placed will extend beyond the outside edge of this strip about three inches (Figs. 1 and 2).

Wall Forms

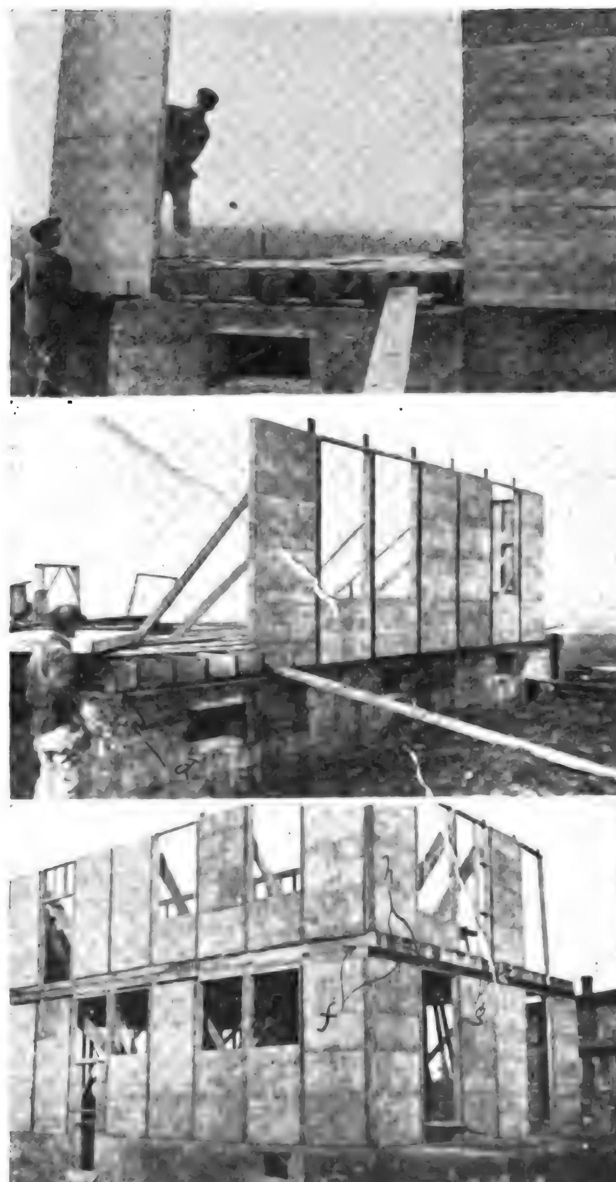
The forms are made in units generally 3′ 8″ wide of a height equal to the distance from top of foundation wall to bottom of support for second floor beams, in the case of first story, and equal to distance from second floor level to the under side of roof beams in the second story. The frame work of the form consists, except in the case of the top and bottom members, of 1″ dressed lumber. Of the four uprights, the two intermediates are 1″ x 5″ and the two outside are 1″ x 4″. The cross pieces in the case of intermediate are 1″ x 4″ and at the top and bottom 2″ x 4″. From side to side of the framework are stretched and securely fastened by staples, No. 10 wires, spaced approximately 15″ apart between cross timbers (Fig. 5).

Over the framework and wires is placed and securely fastened a two-ply tar paper (Figs. 2, 3, 4, and 5), the whole, constructed as above described, making up a unit of the forms against which the outside wall is shot or applied and to which the inner plastered walls are constructed.

Erection of Forms for Walls

The forms were then erected in place, the 2 x 4 bottom cross pieces extending under the ends of the floor beams and butting against the 2 x 6 that was laid on the foundation.

The forms are so placed as to leave a 4″ space between each unit for the purpose of forming the studs (Figs. 2 and 3). Each unit is connected to its mate by a 1 x 6 board nailed to the 1 x 4 edge of each unit, thus providing the back form for the stud and at the same time making the inner face flush with the 1 x 5 uprights of each unit (see *b*, Fig. 5).



Figs. 1, 2 and 3—Setting Up Forms for Gunite Houses—See Text References

Before attaching the 1 x 6 strip on stud forms there is fastened to it angle clips punched with 5/8″ holes in outstanding leg and spaced, one near bottom and at intervals of 3′ upward, and so arranged that when the 1 x 6 strips are nailed in place the clip will extend into the center of the stud.

Reinforcement of Studs

The studs are reinforced in each case by two 1/2″ bars spaced 3 1/4″ o. c., and passing through the 5/8″ holes in

[1]Concrete, July, 1920.

the clips. Each stud is anchored to the foundation by a short $\frac{3}{4}''$ anchor bar previously cast in the concrete foundation and left to project into the stud about 6″ (see *d*, Fig. 2).

Corner Studs

In the case of the corners the inner surfaces of the studs were formed by the sides of the adjoining form units (*e*, Fig. 4). The angle-clips were in this case attached to the side members of the form units, and a bar in one set of slips omitted, leaving three $\frac{1}{2}''$ bars in each corner stud.

Floor Beam Supports

After setting up the first floor form units and connecting them, a 2 x 6 timber was placed edgeways on top of the 2 x 4 top members of the form units, with its inner face flush with the inner edge of the 2 x 4's (see *f*, Figs. 3 and 4); this to serve in part as a support for the floor beams of second story and in part as a backing against which to shoot the gunite.

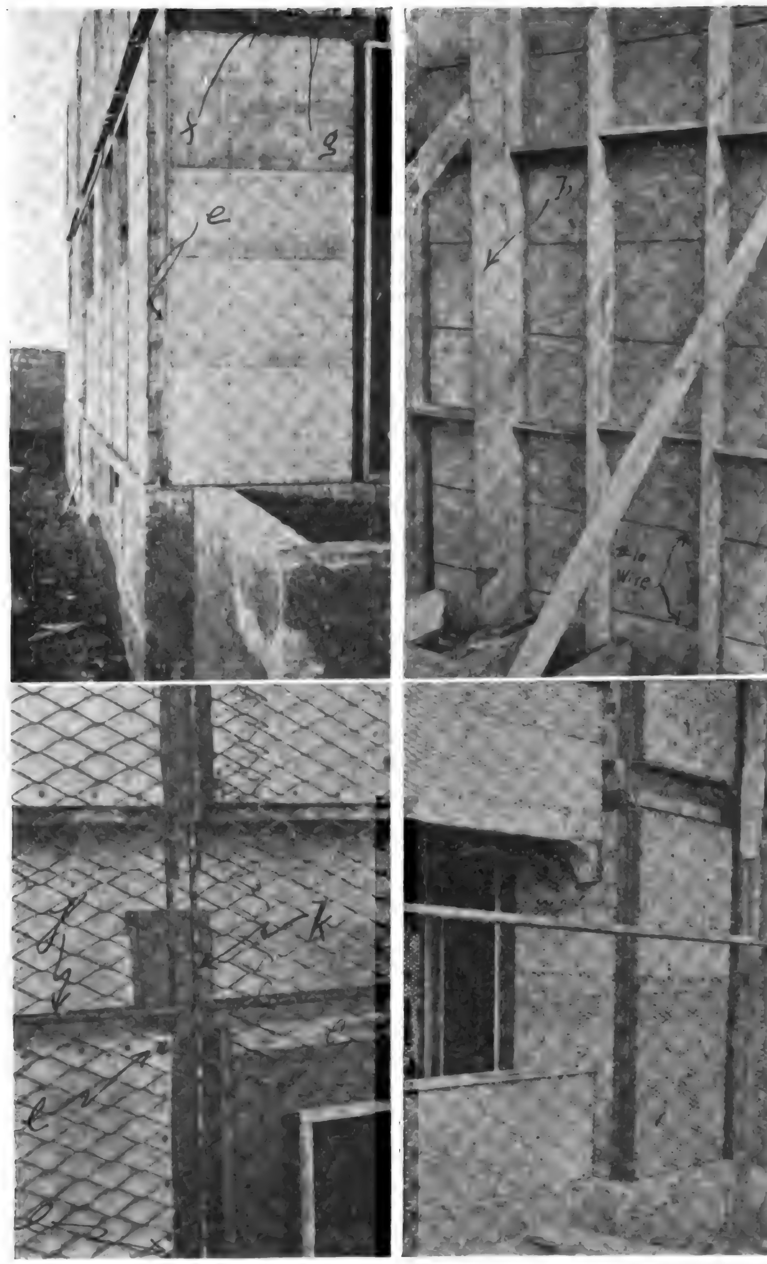
The framework for the interior partitions was then erected and the floor beams for the second story put in place so that their ends rest upon the 2 x 6 and extend 2″ beyond its outer face (*g*, Figs. 3 and 4). The space between the ends of the floor beams was then filled in with 1 x 8 boards placed with outer faces flush with the 2 x 6 immediately below (*h*, Fig. 3).

Fire Stop Between Floors

The space between the outer edge of the 2 x 6 and the face of the form units acts as a form for a reinforced gunite beam, which in turn not only serves as a support for the floor beams, but, in connection with the gunite between ends of floor beams, as an effective fire-stop between the first and second stories.

The gunite beam is reinforced on its tension side by two $\frac{1}{2}''$ steel bars (*j*, Fig. 7).

The second story form units were constructed and erected in the same manner as those of the first story, with practically the same arrangements for roof supports as those described for the floor supports of second story. In the case of the studs, the same reinforcement was used, the upper bars being spliced to those below by means of wiring (*k*, Fig. 7).



Figs. 4 and 5 (Top)—Figs. 7 and 8 (Bottom)—Gunite House—See Text References

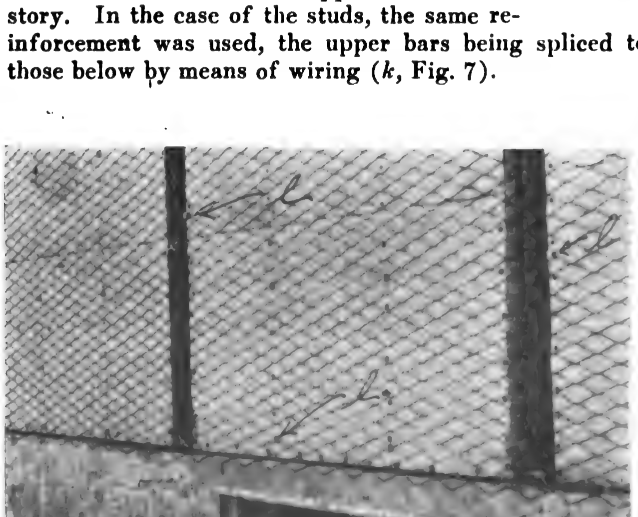


Fig. 6

Wall Slab Reinforcement

Over the forms when fully erected was placed 2″ No. 13 steelcrete reinforcement (Figs. 6 to 9), and firmly attached to the forms by special mesh clamps (*l*, Figs. 6 and 7), which not only secured the reinforcement but holds it away from the tar paper surface about $\frac{1}{2}''$. In all cases where the reinforcement crossed studs it was firmly wired to the outside reinforcing bar.

Gunite Exterior Walls

Gunite composed of one part portland cement and four parts well graded crushed slag passing a screen of $\frac{3}{8}''$ mesh was then applied in the usual manner with the cement gun, working under an air pressure of from 30 lbs. to 40 lbs. per sq. in., to a finished thickness of 2″, using such special wooden shooting strips as were necessary to insure square and true corners.

The gunite was applied in three coats, the first being about 1″ thick or sufficient to embed the mesh reinforcement, and as this coat was applied the studs and beams were shot. When the first coat had hardened a second

coat was applied approximately ¾" thick, after which the surface was gone over with a trowel or screed to remove irregularities. The final or flash coat was then applied to a thickness of ¼", or sufficient to complete wall to a total thickness of 2", leaving the surface the standard gunite finish. Fig. 10 shows the structure complete outside.

Interior Walls

To the strip forming the back of the studs and to the inner edge of the uprights of the form units, which are flush with stud strips, metal lath will be attached and plaster applied by the ordinary hand methods, thus leaving a 5" air space between the inner and outer walls, with a gunite fire stop between floors.

Fireproof House at Sharon, Conn.[1]

The Residence of Dr. Charles Gilmore Kerley, Sharon, Conn.

The house illustrated is the summer residence of Dr. Charles Gilmore Kerley, at Sharon, Conn., and was built by Eggleston and Livingstone, from designs by C. B. Brun. Its walls and floors are of concrete, the roof is of concrete, the stairs, porches, fireplaces, and chimneys are of concrete—even the vitrified clay flue lining, usually considered essential in a concrete chimney, has been omitted.

The house was poured for the most part in wood forms, which were removed as soon as possible. The exterior walls, finished in the concrete itself, are without a stucco coat. The main portion of the house is 62' x 28', and there is a wing without attic, 26' x 23'. This house was built complete, including plumbing, with the best of fixtures, electric wiring, and steam heating apparatus, at a cost of 7½ cts. per cu. ft. of the total cubic contents of the house.

The basement walls of the house are 12" thick and the walls are of reinforced concrete, for the most part of plain flat slabs, 4½" thick. There are long beams in the living room and cross beams in the dining room, forming square panels. Elsewhere the ceilings are flat and the beams have been placed in the walls or partitions. The roof beams, or rather rafters, are also of concrete, 8" wide and 10" deep, and 4' to 5' c. to c., and the slab 4½" thick. The main stairway and the servant's stairway are both of reinforced concrete. Reinforcing is of round bars and Clinton wire cloth in floors, and round bars in walls.

Exterior Finish

The principal construction was in wood forms, which were removed as soon as possible. The outside was gone over with a trowel or an axe to remove all projections. It was then swabbed with a thin mixture of water, sand and cement to fill the surface, and rubbed down with a float. This was not applied as a coating, but simply as a filler for pores in the surface, giving a result very much like the ordinary sand finish so common in interior work. The surface was later brushed over with a mixture of white cement and water.

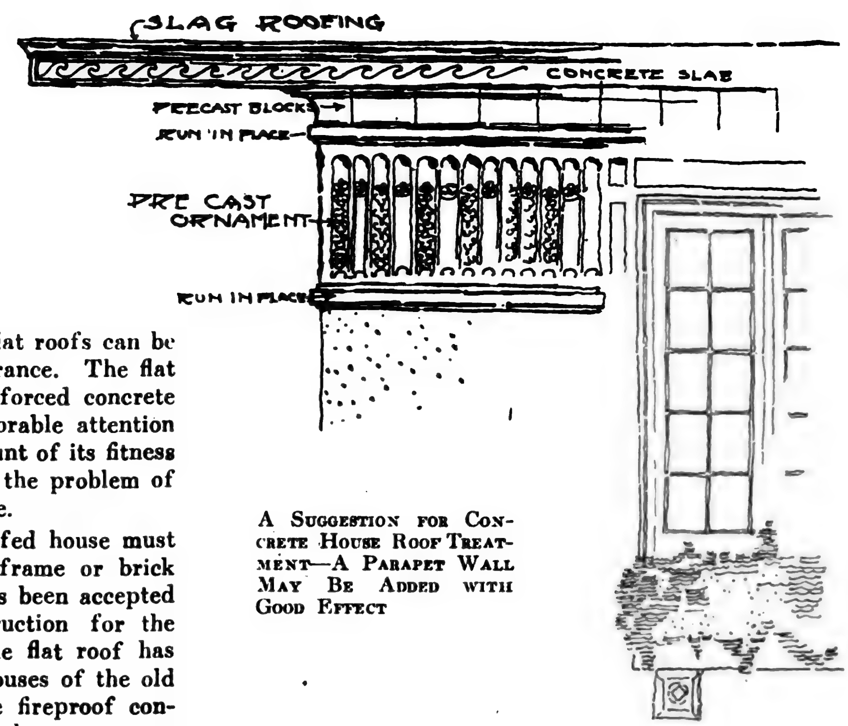
The roof, which was left in natural cement color, was thought by the owners to give too large and monotonous an area, taken together with the house, of white and gray surface. This was due to the absence of large trees to break up the surfaces. For this reason, after the completion of the house, the roof was covered with red tile laid on a wood frame, over the concrete roof.

The architect makes a special point of the fact that in spite of the absence of any waterproofing preparation in the walls, and in spite also of the fact that plastering was applied direct on interior wall surfaces, there has been no dampness, either from penetration or from condensation. The plastering is very thin. The walls were particularly true and a thin coat only was necessary.

[1]Concrete, January, 1917.

Roofing the Small House[1]

By Milton Dana Morrill
Architect, New York City



A Suggestion for Concrete House Roof Treatment—A Parapet Wall May Be Added with Good Effect

Small and medium sized houses with flat roofs can be so designed as to be attractive in appearance. The flat roof is the logical type for use in reinforced concrete construction and is bound to excite favorable attention from an architectural standpoint on account of its fitness and because it is the natural solution to the problem of roofing the concrete and fireproof house.

There is no question that the flat roofed house must differ in appearance from the typical frame or brick dwelling. But just as the pitch roof has been accepted as the most fitting and natural construction for the American dwelling built of wood, so the flat roof has been used for at least 90% of all the houses of the old world, where more permanent and more fireproof construction has been the rule. After we become accustomed to flat roofs, they will be considered, here in America as they have been abroad, the most beautiful and best adapted type for use on our concrete houses. It is only necessary to show to the public a few examples of well designed houses of this style in order to start the movement.

Heretofore the concrete house has inclined to follow architectural lines which were fitting enough in wood or brick, but which are out of place and illogical in concrete design and in concrete construction. We made our concrete to imitate stone blocks. We used forms and styles not natural or suited to reinforced concrete design. Properly made concrete, as a structural material is infinitely better than wood, brick, stone or tile. Then why should we try to imitate these? Why not use our concrete in the most straightforward, logical way, letting the beam, the slab and the lintel predominate? The horizontal lines, the long low effect, with projecting eaves, are natural forms for reinforced concrete, and the flat roof fits in especially well in this type of design. Just as the vertical lines, the narrow and high windows were suited to and beautiful in the stone vaulted Gothic architecture, just so the horizontal lines, wide openings, and projecting flat eaves are natural architectural as well as structural forms in reinforced concrete. Where well proportioned they can be made equally beautiful..

Roof Drainage

The simplest design of the reinforced concrete roof is, of course, the flat slab of uniform thickness, graded to the center of the house, where all of the roof water can be taken down. In a cold climate, where in winter the roof will be covered with snow, this inside down spout obviates any danger of the water freezing and backing up, which is a great difficulty encountered where the roof pitches to outside eaves. In the flat roof the wide projecting eaves or cornice is molded together and at the same time as the roof slab so that the reinforcement is continuous and extends out over the walls to the eaves line.

The ceiling in the rooms is furred down level. It is then lathed and plastered to give an air space and to prevent condensation. A slag roof covering may be laid directly on the concrete slab. In this way we can get both a permanent and at the same time an inexpensive roof covering. There is no waste space in the flat roof and the roof area is reduced to a minimum, so the economy of this type of roof can hardly be questioned.

Ornamentation

While in the flat-roofed houses straight lines will naturally predominate, these houses may be as rich in ornament as desired. Recessed panels may be left in the molded walls in which precast ornamental tile may be set, belt courses may be added. The overhanging cornice may be enriched. The window sills may be molded or flower boxes may be used as decoration. In fact, there is hardly any limit to the amount of decoration that can be applied in the way of low relief or inlay work. Flat surface or color inlays seem especially adapted to the decoration of the concrete house. Perhaps the most pleasing finish for the concrete walls is a dash coat of white portland cement. This gives a permanent finish which weathers well and makes a fine background for evergreen shrubs and clinging vines.

The public taste in house architecture in this country fortunately is improving and the ginger-bread house, cut up with its towers, its bays and its roof that fairly bristles with dormer windows, is almost a thing of the past. We are returning to simple, straightforward designs more on the lines of the old Colonial houses. This change of taste is fortunate for us, as concrete architecture lies along these lines. The English half-timber houses were beautiful and picturesque. It was good architecture, because it was honest construction. It was a natural development from the practice of first putting up a heavy wood frame structure and filling in the walls with masonry. To try to imitate these half-timber in the reinforced concrete construction of houses is not good architecture, because it is not natural construction and use of the material in hand. If we can blot out the sham and the imitation from our designs then we can develop a real concrete architecture in house work.

[1]Concrete, January, 1917.

What Shall Be Done About the Surface?[1]

By Harvey Whipple
Editor Concrete

The simplest possible development of the available resources of the concrete industry in meeting present needs in the scarcity of dwelling houses is undoubtedly in the use of plain, rough-face concrete building units, block and structural tile, or of monolithic walls, covering up the exterior surface with stucco, insuring, if the job is at all well done, not only a good weather-tight wall, but providing a choice of any one of a number of attractive surfaces.

Stucco Surfaces

With a good base coat of stucco, the final treatment of the surface may vary from a fairly smooth sand finish in gray, white or tints, depending upon whether white or gray cement or mineral colors are employed in the mix, to a rough dry dash, in which pebbles or crushed stone may be used for a wide variety of colors and textures. In between these two, there are many choices for stucco finish. One may prefer the soft and not too exact surface planes of the plastered effects, which give such charm to the Connecticut home about which Mrs. Holland writes so enthusiastically (see page 211). There is the surface which is common to a good deal of the work in monolithic house construction, over which Milton Dana Morrill has had supervision—in method not unlike that on the Holland house, adapted to smooth monolithic walls in one coat work, in which the distinguishing characteristic is in the fact that the application is made by skilled artisans with but one stroke of the trowel to any one portion of the surface. The same effect in the final coat might be obtained in two-coat work that would be advisable on concrete block. This one-coat work has frequently been commented upon in connection with Morrill houses, not only because of the attractive character of the final result, but because of the fact that the method appears to have solved a difficulty in cleavage. It is common knowledge that excessive troweling of a surface coating, whether of stucco on a wall or of top surface on a sidewalk or floor, tends to pull the surface coat away from the base and destroy a good bond which is set up where good pressure and the fewest possible operations are employed in getting the surface in the condition in which it is to remain. The very freedom and frank plastered effect of such a surface is very attractive. An example of such a surface is shown on page 20 not to the best advantage, because the contrasting whiteness of the wall and the deep green of the vine which trails over it caused the photographer to lose much of the detail in the wall surface itself. Such a surface is by no means impossible on a concrete block wall, although as already mentioned it must undoubtedly be obtained in the second coat.

There are various degrees of stucco roughness available—even an extreme rustic gobbiness which is possible with the rough cast or spatter dash finishes and with more colorful qualities if the dry dash stucco in which colored pebbles or crushed stone are thrown into (sometimes further pressed in) the final, freshly floated coat of stucco while it is still soft.

Equally good color results and much more even textures are undoubtedly obtainable by the methods used by John J. Earley, the Washington sculptor, discussed in detail in an American Concrete Institute paper published in this volume. Such a surface is obtained by using a selected aggregate for the final coat and washing out the surface cement and cleaning up with an acid solution.

Block Surfaces

The block manufacturer should not in the present emergency, when he is desirous of furthering the freest possible use of his product, permit the fact that in stucco covering his product is out of sight, to blind him to the architectural possibilities of concrete block as a facing unit.

A good block, well laid up, needs no covering, either for weather tightness or for finished attractive appearance. The stucco wall is essentially monolithic in effect if not in fact; its beauty dependent upon good proportions and good texture suited to broad effects. A wall built up of small units is another matter, and many people will always prefer such a wall when it is well built. In this the final effect is dependent not only upon the treatment of spaces with respect to the proportions of the units employed, but also upon the architectural quality of each unit as it must blend in an assembly of units. This does not mean that any individual house, which must be economically built, is to be built of ugly units because the alternative is a faced unit in which the cost of facing materials and labor in placing and finishing them have made the price prohibitive from the standpoint of the modest purse.

Look at some of the pictures among the special plates shown on pages 19-22. There is the attractive result obtained by R. H. Bushnell with plain face block in two textures, fine and coarse intermingled, without the use of any expensive facing mixture, or any excessive labor in finishing.

See the effect of plain rough face block in the houses at Morgan Park, built several years ago for the Minnesota Steel Co., whose walls time has helped to finish.

Coarse Facing Mixtures

Coarser facing mixtures, even when no special color aggregates are employed, give results far more attractive than the fine sand mixes so commonly used. An individual block may look excessively rough and unfinished and still a wall of such units possess real character. This is particularly true when in various lots of block there is some variation in the shade of gray.

[1]From Concrete, January, 1920, p. 12.

When the different lots are mixed up the result is to be preferred to a one-tone wall.

It is footless to elaborate upon the desirability of employing more varieties of facing aggregates. This magazine may almost be said to have "harped on" the subject for years. Most localities have ledges or quarries or pits of materials which have only to be looked at with a new imaginative eye to be recognized for their special value to the manufacturer of concrete products.

One locality has a special gravel, or quantities of field stone, or quarries offering something of value. By all means make use of native materials and reduce the cost of beauty in your work. Install a small crusher; reduce the native materials to sizes that are suited to the thing that is to be done. Don't be satisfied with another man's formula. Work out something new and local. But first of all, try to reduce the amount of *paste*, the amount of mortar in the facings. Use no more fine cement and stone dust than is absolutely necessary. There is a groundless notion that a facing mix must be as rich as one to three—some insist upon one to two. Make it one to five by using coarser materials—as large as can be kept in place in the tamped products, or as large as inch and a half in pressed or wet cast work.

Then use a two-dollar spray nozzle and apply water at the right time to remove the surface film. Assist the removal of this film with a brush. The installation of a suitable sump and a grating to minimize the muss, the training of one man to the job, learning just the right time to do the work with respect to the hardening process, the proper organization of the work to get it on a quantity speed basis—these preliminary investments should give results in increased value and salability of the product to vastly increase the profits.

It is entirely a matter of organizing the work and systematizing it, so that handling products for these superior results is not a matter of the exceptional operation in the factory, but one of first consideration.

Get away from the idea that a concrete block is for cellar walls.

As for "rock face" and so on, try to forget. A wall of rock face block is usually a nightmare. Some rock face block are worse than others; all are bad when any number of them are seen together, no matter how good any one imitation may be all by itself.

Get out of the habit of judging samples. Never forget that concrete block are not used singly, that they are not looked at through a reading glass.

The only place a concrete block does any good is when it is one of many similar units, well laid up in a wall. People look at walls, not at blocks; they buy houses, not little pieces of building material 8 x 16 or 9 x 24.

Did you ever face a block with cinders or slag? Try it. Don't pass judgment on the job until you have laid up a wall of the stuff.

They built some small monolithic wall cottages in a certain place once; the forms sprung and they had to chip off the concrete to an even plane. It was cinder concrete—result, a beautiful wall—an accident. A concrete wall is not a piece of bric-a-brac. Get away from the slick looking stuff.

But whatever you do, let it be evident that your concrete units are made of concrete. Let it appear on the surface that they are a composite.

Monolithic Wall Surfaces

The logical treatment of surfaces in monolithic walls depends upon the governing conditions of construction.

If form units come down to leave the surface accessible in from one to three days, depending upon hardening conditions, bristle or wire brushes will do wonders, especially if the walls are washed with plenty of water at the same time. Such a treatment must be carried forward systematically as forms are removed, because if one part is left too long, it can never be made to match the work that has been brushed out at some earlier stage of hardening.

Imperfections may be pointed up with some care to match the general surface texture, and the whole work gone over with a cement wash, or with whitewash, as described so attractively by Mr. Andrews in connection with his "thousand year house," in this volume, or with a wash in color tone with mineral colors, or with cement paints and stains made especially for the purpose.

The best treatment of a surface is the one that is most logical, the one that is indicated by the character of the work. The truly architectural result is always obtained when a structure stands plainly for what it is, expressing how it came to be, revealing what it is made of.

A monolithic wall may consistently be picked or bush-hammered, or if the forms have left the surface reasonably true, the surface may be made entirely attractive with slight rubbing.

A little care in the form work avoids many cares in finishing the resulting surface. Even with the double wall machines, careless handling, uneven tamping, frequently result in such pits and ridges at each tier that heavy application of stucco is necessary to bring walls to approximately true planes. Careful workmanship such as a man may be expected to apply when he once has the habit from proper training, cuts down the cost of the stucco work very materially.

With unit steel forms, as mentioned elsewhere in connection with work of Milton Dana Morrill, the job may be handled so that stucco in a very thin coat only meets every requirement for a satisfactory result.

The most noticeable achievement in this direction that has come to the writer's attention is in the work done with the Ingersoll forms at Phillippsburg, N. J., by Paul Smith, for the Phillippsburg Development Corporation, where the surfaces are so true that satisfactory results are obtained with one thin coat. A patent stucco in tints is spattered on with brushes at a total cost of only about $75 for labor and material on the six-room houses which are illustrated on other pages.

A few builders have been brave enough to let the walls stand with the form marks in evidence. Frank Lloyd Wright did this on some very pretentious and otherwise costly work. But it is too much to expect that unless the form work is most carefully done the results thus obtained will be popular for residences that stand close up to the thoroughfare on well-groomed city streets. The rusticity of such effects demands a compensating rusticity in the setting.

Still further possibilities for the enrichment of concrete surfaces are in the use of inserts of burned tile or mosaic marble, this work being discussed with illustrated examples in other articles which follow.

Burned Clay Inserts in Concrete Surfaces[1]

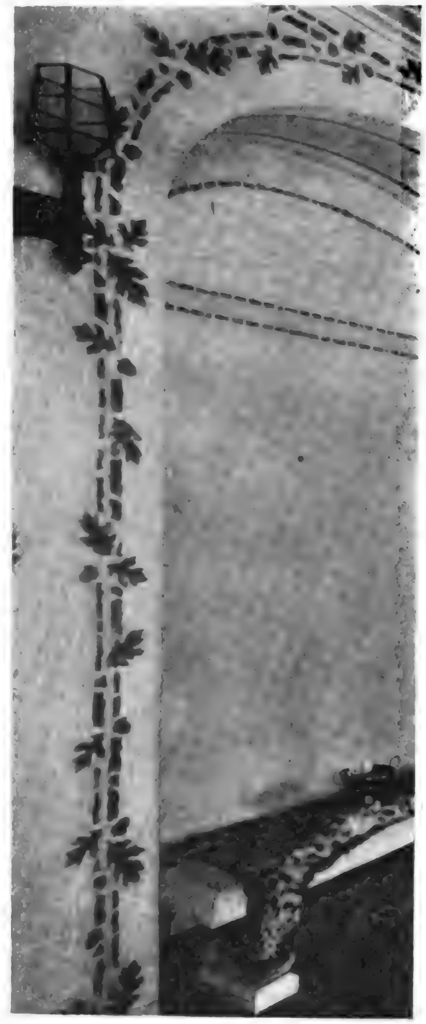
The residence of Schuyler Schieffelin, Monroe, N. Y., claims features of particular interest, because of the way in which the architect, Bowen Bancroft Smith, has solved the problem of decoration of interior wall surfaces. The walls in the principal living rooms have been finished in cement stucco having a uniform but not too smoothly floated surface, and enriched by certain detail of ornament such as grotesque heads, corbels, caps, etc., executed in cast concrete. Hangings of antique tapestries and embroideries, colored marble bases and fireplace details and rich tile floors, give warmth and color, but the principal motif in the decoration of these cement surfaces is a very original treatment by inserts of special tile. Illustrations from the photographs fail to convey an adequate idea of the colors and tone values which produce such finished beauty in these walls.

It was intended to recall by these tile the foliage of the surrounding hills, and Mr. Smith selected oak and maple leaves as suitable for the purpose and designed borders for the several rooms consisting of groups of leaves connected by conventional stems or borders. Oak leaves were used for the main entrance vestibule and maple leaves for the main stair hall above, while simple straight line borders decorated the walls of the stairway intervening and connected the more elaborate motifs.

The tile themselves are real works of art, and the final results were only achieved after tedious and costly experiments to which Herman Mueller, of the Mueller Mosaic Co., Trenton, N. J., devoted much of his personal time. The colors of the leafage are very beautiful, the oak leaves particularly having in the tile replica not only the color but the surface value of the natural leaf.

Workmen, though skilled in ordinary tile setting, were not trusted to set the tile into the walls without a most detailed design to guard against any failure in carrying out the architect's intention. Complete full size details were made showing each individual piece of tile, leaf or stem, and the tile were glued, face downward, to these details, which were first cut into sections having approximately 4′ or 5′ of surface area and each indexed and marked for location.

In preparation for setting, beveled wood grounds were applied bounding on every side the position for all borders, etc., and these were marked and indexed to correspond with the notations on the drawings. This done, the walls were scratch-coated with cement mortar and afterwards brown coated in the usual manner, but before the brown coat was set the tile were applied sheet by sheet, as in mosaic work, care being used to register the notations on the drawings with those on the grounds corresponding. The tile were then firmly pressed into the cement flush with the face of the grounds, and when nearly set the paper was moistened and removed and where needed the individual tile were readjusted by hand. The next step was to remove the temporary wood grounds and fill in the chases, after which the finish coat of cement was applied over all wall surfaces but immediately wiped off the tile surfaces, leaving them bedded flush with the finished cement walls.



Detail of Tile and Plaster Trim

The decorations are specially designed and made tile in natural colors. The tile are set flush with the cement plaster.

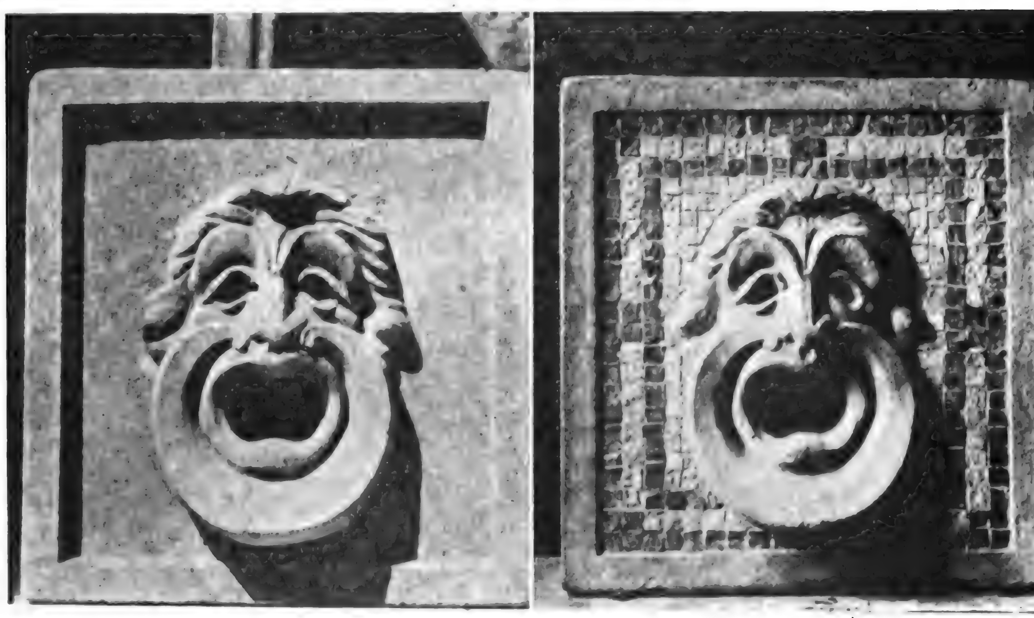
The scratch and brown coats were mixed with Medusa waterproofing compound as preventive against stains from possible dampness, and surfaces were stippled with a gray preservative coating to give a uniform surface tone.

The interest that attaches to this work of Mr. Smith cannot be regarded as lying wholly in the success of the precise design or treatment which he has given to these particular interior walls, but for those who are studying the development of concrete and its surface treatments, the chief value must lie in Mr. Smith's exhibition of originality in going into new fields to bring new beauties to concrete surfaces and because he has adapted them to new uses in residence work.

The demand for concrete houses increases, and will increase more rapidly as owners come to realize that they are cool in summer, warm in winter, fireproof and permanent in construction, and architects are beginning to direct their thoughts to devise honest treatment for concrete surfaces, which will express the material, emphasize its qualities and its wide range of possibilities in surface treatment. The field has only been scratched, and no doubt new methods and new ideas will result from the growing interest in this material.

[1]From an article in CONCRETE, January, 1917.

Comparison of Plain and Mosaic Filled Wall Fountains



Mosaic Enrichment of Concrete Surfaces[1]

By Charles T. Scott
School of Industrial Art, Philadelphia

The very simple method of introducing color and design in large or small areas of widely varying character by means of mosaic is of great antiquity. The materials used are small squares of marble or glass of different colors, even including gold, and rich cement mortar.

The mosaic is formed by squares of marble from ¼" x ¼" to 1" x 1", and about ⅜" to ½" thick; these have been sawed and have a level surface on each flat side. They are more or less readily split by a very short cold chisel, the stone resting on an iron block or anvil. The stones or tesserae, as they are called, can be laid with the rough or split surfaces out, as in the triangular pattern of one of the urns illustrated, or with flat surfaces exposed as in the other illustrated object. In many cases the depressions necessary to contain the tesserae can be cared for in the mold or form, in others the spaces can be lowered by chiseling out the concrete before it has become too hard.

The stones may be soaked in linseed oil for several hours to make their color brighter and then set in soft mortar, or they can be used as they are after wetting them.

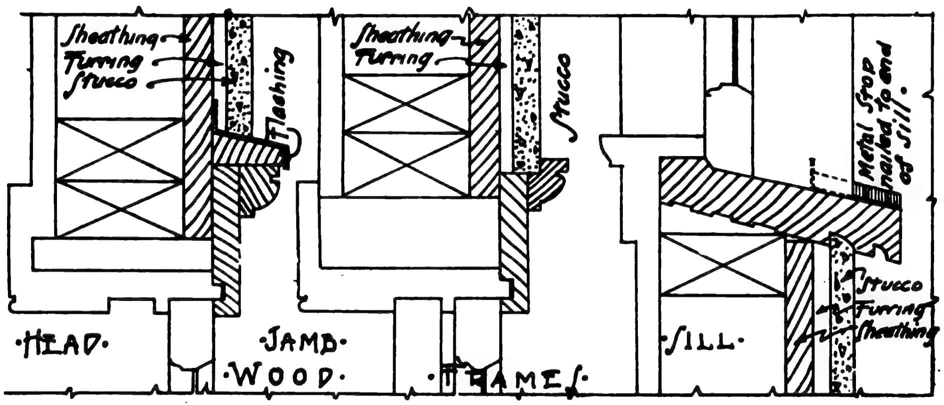
Sometimes for flat panels in walls or floors, the stones are glued on paper, face down, with gum arabic.

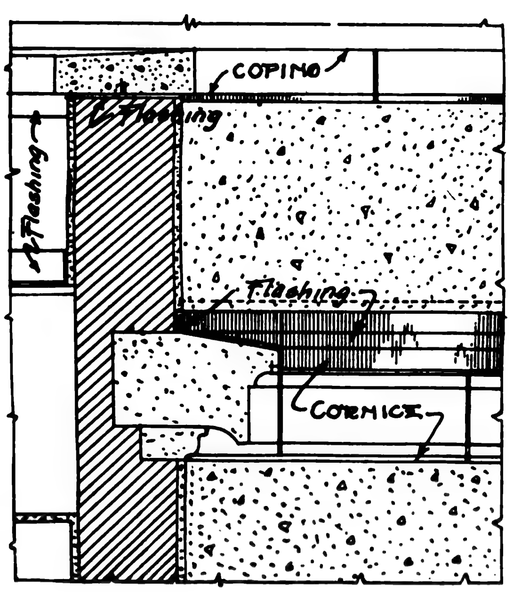
The soft mortar bed is then laid and the design reversed and laid in the wet surface. It is then pressed down and leveled with a heavy block and the paper soaked off.

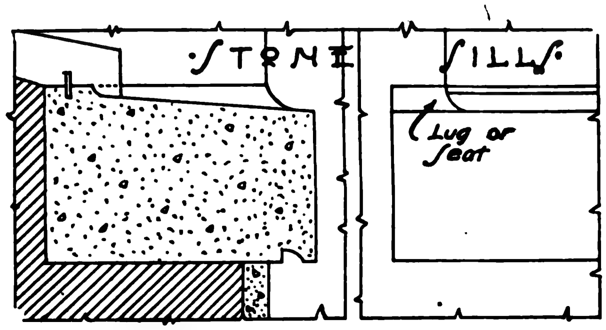
[1]Concrete, January, 1917.

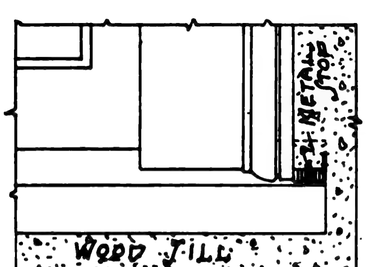
Garden Ornaments of Concrete, with a Touch of Color

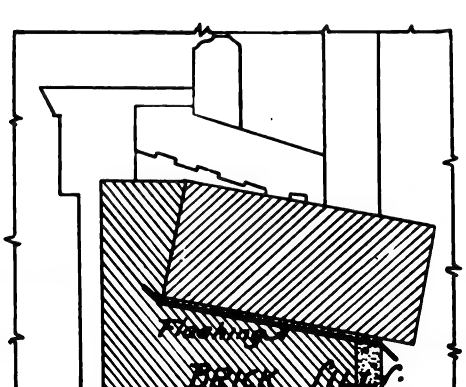
Flashing Details in Stucco Practice

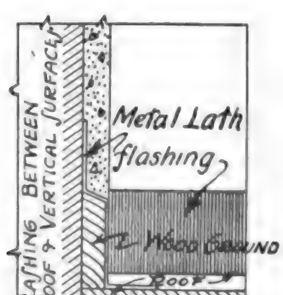












Standard Recommended Practice for Portland Cement Stucco[1]

The importance of good practice in stucco work at this time, when much of it will be done, particularly in house construction, seems to warrant the publication here in full of the recent report of the Committee on Treatment of Concrete Surfaces of the American Concrete Institute—consisting of Standard Recommended Practice for Portland Cement Stucco. The Proceedings of the American Concrete Institute for several years past testify to the work done by the committee, particularly that under J. C. Pearson, chairman of the committee, at the United States Bureau of Standards. The Recommended Practice here offered, while probably by no means the last word on the subject, is well considered—so well that it was received by the Institute at its recent convention in Chicago and passed to letter ballot of the membership. [Adopted as Standard Practice April 17, 1920.—Editor.]

General Requirements

1. *Design.*—Whenever the design of the structure permits, an overhanging roof or similar projection is recommended to afford protection to the stucco. Stuccoed copings, cornices and other exposed horizontal surfaces should be avoided whenever possible. All exposed stuccoed surfaces should shed water quickly, and whenever departure from the vertical is necessary, as at water tables, belt courses, and the like, the greatest possible slope should be detailed. Stucco should not be run to the ground whenever other treatment is possible. Should the design of the structure require this treatment, the backing should be of tile, brick, stone, or concrete, providnig good mechanical bond for the stucco, and should be thoroughly cleaned before plastering. Unless special care is taken to thoroughly clean the base and each plaster coat from dirt and splash before the succeeding coat is applied, failure of the stucco may be expected.

2. *Flashing.*—Suitable flashing should be provided over all door and window openings wherever projecting wood trim occurs. Wall copings, cornices, rails, chimney caps, etc., should be built of concrete, stone, terra cotta, or metal, with ample overhanging drip groove or lip, and water-tight joints. If copings are set in blocks with mortar joints, continuous flashing should extend across the wall below the coping and project beyond and form an inconspicuous lip over the upper edge of the stucco. Continuous flashing with similar projecting lip should be provided under brick sills. This flashing should be so installed as to insure absolute protection against interior leakage. Cornices set with mortar joints should be provided with flashing over the top. Sills should project well from the face of the stucco and be provided with drip grooves or flashing as described above for brick sills. Sills should also be provided with stools or jamb seats to insure wash of water over the face and not over the ends. Special attention should be given to the design of gutters and down spouts at returns of porch roofs where overflow will result in discoloration and cracking. A 2-inch strip should be provided at the intersection of walls and sloping roofs and flashing extended up and over it, the stucco being brought down to the top of the strip.

3. *Preparation of Original Surface.*—All roof gutters should be fixed, and downspout hangers and all other fixed supports should be put in place before the plastering is done, in order to avoid breaks in the stucco.

Metal lath and wood lath should be stopped not less than 6 in. above grade to be free from ground moisture.

All trim should be placed in such manner that it will show its proper projection in relation to the finished stucco surface, particularly in overcoating.

Notes on General Requirements.—Successful stucco work depends in large measure upon suitable design of the structure *for stucco.* Exterior plaster of any kind merits whatever protection can legitimately be given it, and while concession must sometimes be made to architectural requirements, there is rarely any necessity for subjecting stucco to an exposure which it cannot reasonably be expected to withstand. Even where stucco will remain structurally sound, it is sometimes wiser to use other treatment for the sake of appearance. For example, it is better not to run stucco to grade, not only because of the danger from frost action, but also to avoid staining of the stucco from dirt and moisture. For the same reason special attention should be given to details of flashing and drips, wherein a little foresight will prevent much unsightly discoloration, and possibly more serious defects.

A fundamental rule in the design of a stucco structure is: "Keep water from getting behind the stucco." The architect should go even further than this and endeavor to keep any concentration of water flow from getting at the stucco at all. Real study of methods of avoiding damaging leaks and drips, and of providing properly for roof drainage will be well repaid.

Paragraphs 1 to 3 contain definite suggestions for stucco protection. These are supplemented herewith by the simple drawings which show typical details for such protection.

Masonry Walls.

4. *Tile.*—Tile for exterior walls should preferably be not less than 8 in. thick, and should be hard burned, with dovetail or heavy ragged sooring. Tile should be set in cement mortar composed of one part cement, not more than one-fifth part hydrated lime and three parts sand, by volume. The blocks should not vary more than 1/4 inch in total thickness and should be set with exterior faces in line. Joints should not be raked, but mortar should be cut back to surface. Neither wire mesh nor waterproofing of any type should be applied to tile walls before plastering. The surface of the tile should be brushed free from all dirt, dust and loose particles, and should be wetted to such a degree that water will not be rapidly absorbed from the plaster, but not to such a degree that water will remain standing on the surface when the plaster is applied.

5. *Brick.*—Surface brick should be rough, hard burned, commonly known as arch brick. Brick should be set in cement mortar with joints not less than 3/8 in. thick, and the mortar should be raked out for at least 1/2 in. from the face. The surface of the brick should be brushed free from all dust, dirt and loose particles, and should be wetted to such a degree that water will not be rapidly absorbed from the plaster, but not to such a degree that water will remain standing on the surface when the plaster is applied.

Old brick walls which are to be overcoated should have all loose, friable, or soft mortar removed from joints, and all dirt and foreign matter should be removed by hacking, wire brushing, or other effective means. Surfaces that have been painted or waterproofed should be lathed with metal lath before overcoating.

6. *Concrete.*—Monolithic concrete walls should preferably be rough and of coarse texture, rather than smooth and dense, for the application of stucco. Walls of this type should be cleaned and roughened, if necessary, by hacking, wire brushing, or other effective means. The surface of the concrete should be brushed free from all dust, dirt, and loose particles, and should be wetted to such a degree that water will not be rapidly absorbed from the plaster, but not to such a degree

[1]Copyrighted Proceedings American Concrete Institute, Vol. 16, 1920.

that water will remain standing on the surface when the plaster is applied.

7. *Concrete Block.*—Concrete block for stucco walls should be rough and of course texture, but not weak or friable. Block should be set with cement mortar joints, which should be raked out or cut back even with surface. Before applying the stucco the surface should be brushed free from all dust, dirt, and loose particles, and should be wetted to such a degree that water will not be rapidly absorbed from the plaster, but not to such a degree that water will remain standing on the surface when the plaster is applied.

Notes on Masonry Walls.—Buildings of hollow terra cotta tile, brick, concrete, concrete block, and similar materials, are particularly well adapted for the application of stucco because of their rigidity. This, however, depends upon good, solid footings or foundation, a requirement which should be met in all types of stucco structures. Masonry walls should also provide a good surface for the bond or adhesion of the stucco, and wherever possible this bond should be insured by some form of mechanical key. For this reason raking out the joints in a brick wall is recommended as an added precaution, and similarly, walls of concrete or concrete block should not be too smooth, but preferably rough, and of coarse texture.

It is most important that masonry walls be clean before the stucco is applied, as otherwise the bond of the stucco cannot be relied upon to stand the strain set up by moisture and temperature changes. Many a failure of stucco on masonry foundations has been attributed to frost action, when the primary cause of the failure has been lack of care in thoroughly cleaning the walls from dirt. Without secure and positive anchorage under such conditions, the stucco cannot endure.

Special attention should be called to the importance of properly wetting the surface of masonry walls just before applying the stucco. Too dry a surface will absorb the water from the fresh plaster coat before the latter has had time to harden properly. On the other hand a surface completely saturated has lost all its absorptive power, or "suction," a slight degree of which is necessary for best results. A moderate amount of suction tends to draw the fine cement particles into the pores and interstices of the surface; upon this action the bond of the stucco depends. If this bond is to be as strong as possible, the surface should be neither dry nor completely saturated.

Wood lintels over openings in masonry walls should not be used.

When old masonry walls are overcoated special attention should be given to the necessity of obtaining thorough cleanliness, a good mechanical bond, and proper suction. When any of these conditions are in doubt, the walls should be furred and lathed.

Frame Walls

8. *Framing.*—Studs spaced not to exceed 16″ centers should be run from foundation to rafters without any intervening horizontal members. The studs should be tied together just below the floor joists with 1″ x 6″ boards, which should be let into the studs on their inner side, so as to be flush and securely nailed to them. These boards will also act as sills for the floor joists, which, in addition, should be securely spiked to the side of the studs.

9. *Bracing.*—The corners of each wall should be braced diagonally with 1″ x 6″ boards let into the studs on their inner side, and securely nailed to them.

In back-plastered construction in which sheathing is omitted, at least once midway in each story height, the studs should be braced horizontally with 2″ x 3″ bridging set 1″ back of the face of the studs. This assumes that the studs are 2″ x 4″. Larger sizes would require correspondingly larger bridging.

In sheathed construction no bridging is necessary.

Notes on Frame Walls.—Good bracing of the frame is important to secure the necessary rigidity. Bridging between the studs at least once in each story height is recommended whether the frame is to be sheathed or not. In the former case the bridging should be of the same size as the studs (usually 2″ x 4″). In the back-plastered type of construction where sheathing is not used, bridging is required for stiffening the frame, and should be 1″ less than the studs in depth. It should be placed horizontally, and 1″ back of the face of the studs, in order that the back-plaster coat may be carried past the bridging without break at this point. Diagonal bracing at the corners of each wall is recommended, especially when sheathing is omitted. Such bracing may be of 1″ x 6″ boards, 6′ or 8′ long, let into the studs on their inner side in order not to interfere with the back plastering or the interior plastering. The length of the corner bracing will, of course, depend to some extent on the location of window or other openings.

The committee feels that fire protection is an important feature of this type of structure, and that some form of fire stop is necessary to develop its full fire resistance value. Probably the best method is to form a basket of metal lath to occupy the spaces between the studs at the juncture of the floor joists and wall. This should be filled with cement mortar or concrete from the ceiling level to 4″ above the floor level.

A preliminary report from the Underwriters Laboratories on back-plastered metal lath and stucco construction with portland cement indicates that "this finish can be expected to furnish a substantial barrier to the passage of flame into the hollow spaces back of it and to provide sufficient heat insulation to prevent the ignition of the wooden supports to which it is attached for about one hour when exposed to fire of the degree of severity to which stucco buildings are likely to be subjected under average exterior fire exposures."

The committee wishes to recognize the development of metal lumber for frame construction, and believes its merits are such that its use will undoubtedly largely increase. Detailed reference to this form of construction will be made in subsequent additions to this recommended practice.

10. *Sheathing.*—In back-plastered construction the lath should be fastened direct to the studding and back-plastered, and no sheathing is used.

In sheathed construction the sheathing boards should not be less than 6″ nor more than 8″ wide, dressed on one or both sides to a uniform thickness of 13/16″. They should be laid horizontally across the wall studs and fastened with not less than two 8d nails at each stud.

Notes on Sheathing.—When sheathing is used, it should be laid horizontally and not diagonally across the studs. The stucco test panels erected at the Bureau of Standards in 1915 and 1916 have demonstrated conclusively that diagonal sheathing tends to crack the overlying stucco by setting up strains in the supporting frame. This result is undoubtedly due to the shrinkage of the sheathing, and whatever benefit might be anticipated from the more effective bracing provided by diagonal sheathing appears to be more than offset by the shrinkage effect. Diagonal sheathing is also less economical than horizontal sheathing, both in material and labor.

11. *Inside Waterproofing.*—In back plastered construction no waterproofing is necessary.

Notes on Waterproofing.—Waterproofing of the faces of the studs in back-plastered construction seems to be ineffective and unnecessary, and its elimination is recommended.

In sheathed construction, over the sheathing boards should be laid in horizontal layers, beginning at the bottom, a substantial paper, well impregnated with tar or asphalt. The bottom strip should lap over the baseboard at the bottom of the wall, and each strip should lap the one below at least 2″. The paper should lap the flashings at all openings.

12. *Furring.*—Metal Lath. When furring forms an integral part of the metal lath to be used, then separate furring as described in this paragraph is omitted.

In back-plastered construction galvanized or painted ⅜″ crimped furring, not lighter than 22-gauge, or other shape giving equal results, should be fastened direct to the studding, using 1¼″ x 14-gauge staples spaced 12″ apart.

In sheathed construction galvanized or painted ⅜″ crimped furring not lighter than 22-gauge or other shape giving equal results, should be fastened over the sheathing paper and directly along the line of the studs, using 1¼″ x 14-gauge staples spaced 12″ apart. The same depth of furring should be adhered to around curved surfaces, and furring should be placed not less than 1½″ nor more than 4″ on each side of and above and below all openings.

Wood Lath. Furring 1″ x 2″ should be laid vertically 12″ on centers over the sheathing paper and nailed every 8″ with 6d nails.

Notes on Furring.—The proper type and depth of furring is a question on which information is desired. If metal lath is applied over sheathing and the commonly recommended practice of filling with mortar the space between lath and sheathing is to be followed, there seems to be no good reason for using furring deeper than ⅜″. On the other hand, 1″ x 2″ wood furring is widely used for both metal and wood lath, and there

are good arguments both for and against this type of furring. The question of the proper length and gauge of staples for metal lath is involved with that of furring. The entire subject needs investigation.

13. *Lath.*—Metal lath should be galvanized or painted expanded lath weighing not less than 3.4 lbs. per sq. yd.

Wire lath should be galvanized or painted woven wire lath, not lighter than 19-gauge, 2½ meshes to the inch, with stiffeners at 8" centers.

Notes on Metal Lath.—Metal lath should be specified by weight rather than by gauge, and should be always galvanized or painted. Galvanized lath is a good investment in most cases, and is to be recommended in preferance to painted lath, unless the method of applying the stucco is such as to insure complete embodiment of the metal, as, for example, in the back-plastered type of construction.

Wood lath should be standard quality, narrow plastering lath 4' long and not less than ⅜" thick.

Notes on Wood Lath.—The use of wood lath as a base for cement stucco finds many advocates and many opponents, but the Committee does not feel that it can recommend wood lath for cement stucco, and more field and test data should be available before the evidence for and against wood lath can be carefully weighed. Further information is desired in regard to the type of wood lath best suited for cement stucco. In some of the most satisfactory work reported by the Committee, the lath were of white pine, 1" wide and ½" thick. Both materials and size were here unusual, but the Committee is of the opinion that this type of narrow lath is worthy of consideration. For want of information as to the practicability of specifying any particular kind of wood and unusual dimensions, no change is suggested at the present time. It may be stated, however, that nearly all of the test panels of wood lath erected at the Bureau of Standards developed large cracks, in such manner as to suggest that narrower lath (those used were 1⅜" wide) with wider keys and heavier nailing would have given better results. The tests also indicate that counter lathing in which the lath are applied lattice fashion produces no more satisfactory results than plain lathing. In view of the much greater cost of counter lathing the committee recommends that reference to this type of application be omitted from specifications.

14. *Application of Lath.*—Metal Lath. Lath should be placed horizontally, driving galvanized staples 1¼" x 14-gauge not more than 8" apart over the furring or stiffeners. Vertical laps should occur at supports and should be fastened with staples not more than 4" apart. Horizontal joints should be locked or butted and tightly laced with 18-gauge galvanized wire.

Wood Lath. Lath should be placed horizontally on the furring with ½" openings between them. Joints should be broken every twelfth lath. Each lath should be nailed at each furring with 4d nails.

15. *Corners.*—Metal Lath. The sheets of metal lath should be folded around the corners a distance of at least 3" and stapled down, as applied. The use of corner bead is not recommended.

Wood Lath. At all corners a 6" strip of galvanized or painted metal lath should be firmly stapled over the lath with 1¼" x 14-gauge galvanized staples.

16. *Spraying.*—Before applying the first coat of plaster, wood lath should be thoroughly wetted, but water should not remain standing on the surface of the lath when the plaster is applied.

Application of Lath.—The results of tests and field observations indicate that more attention should be given to the application of lath to exterior surfaces. Cracks frequently develop in stucco over laps or at junctions of metal and wire lath, indicating a weakness at these points. This may be due in part to reduced thickness of the stucco where the lath is lapped, or to insufficient tying and fastening at the joints. The ideal job of lathing would obviously be that in which the lath forms a uniform fabric over the structure, without seams or lines of weakness, and with equal reinforcing value in all directions. This ideal condition cannot be realized, but evidence is at hand to indicate that butted and laced, or well-tied horizontal joints are better than lapped joints, and in the case of ribbed lath, that carefully locked joints are better than lapped joints. Vertical joints must almost of necessity be lapped, but the joints may be made secure if they occur over supports and are well stapled at frequent intervals.

17. *Insulation.*—The air space in back-plastered walls may be divided by applying building paper, quilting, felt, or other suitable insulating material between the studs, and fastening it to the studs and bridging by nailing wood strips over folded edges of the material. This insulation should be so fastened as to leave about 1" air space between it and the stucco. Care should be taken to keep the insulating material clear of the stucco, and to make tight joints against the wood framing at the top and bottom of the space and against the bridging.

Notes on Insulation.—At the present time, the warmth of the back-plastered stucco house in comparison with that of the sheathed house is questioned by some, but the available evidence seems to indicate that where insulation has been provided as specified, generally satisfactory results have been obtained.

Ordinary building paper applied in a double layer is recommended as a satisfactory insulating medium.

In this connection reference may be made to a series of tests conducted in 1919 at the Armour Institute of Technology, Chicago, to determine the relative heat conductivity of various types of walls. These tests indicated that by the use of building paper or quilting, the loss of heat through a stucco wall of the back-plastered type was less, under standardized conditions, than the loss through the ordinary wood frame wall, covered with sheathing and drop siding. A complete report of these tests may be obtained on application to the Commissioner, Asociated Metal Lath Manufacturers, Chicago, Ill.

18. *Overcoating.*—Old frame walls which are to be overcoated should be made structurally sound in every respect, and, as far as possible, the general conditions on pages 1 and 2 should be observed: otherwise the recommended practice for frame structures obtains.

19. *Cement.*—The cement should meet the requirements of the standard specifications for portland cement of the American Society for Testing Materials, and adopted by this Institute. (Standard No. 1.)

20. *Fine Aggregate.*—Fine aggregate should consist of sand, or screenings from crushed stone or crushed pebbles, graded from fine to coarse, passing when dry a No. 8 screen. Fine aggregate should preferably be of silicious materials, clean, coarse, and free from loam, vegetable, or other deleterious matter.

Notes on Materials.—The paragraphs relating to materials are sufficiently specific as to the quality of the stucco ingredients. However, reference may be made to the recently developed colorimetric test for detecting the presence of organic matter in sands, a description of which is to be found in the report of Committee C-9, American Society for Testing Materials, 1919.

21. *Hydrated Lime.*—Hydrated lime should meet the requirements of the standard specifications for hydrated lime of the American Society for Testing Materials.

Notes on Hydrated Lime.—Hydrated lime should be specified to the exclusion of lump lime, chiefly for the reason that lime which is slaked on the job cannot as a rule be so thoroughly hydrated and so thoroughly mixed in the mortar as the mechanically hydrated product.

22. *Hair or Fiber.*—There should be used only first quality long hair, free from foreign matter, or a long fiber well combed out.

23. *Coloring Matter.*—Only mineral colors should be used which are not affected by lime, portland cement, or other ingredients of the mortar, or the weather.

24. *Water.*—Water should be clean, free from oil, acid, strong alkali or vegetable matter.

Preparation of Mortar

25. *Mixing.*—The ingredients of the mortar should be mixed until thoroughly distributed, and the mass is uniform in color and homogeneous. The quantity of water necessary for the desired consistency should be determined by trial, and thereafter measured in proper proportion.

Machine Mixing. The mortar should preferably be mixed in a suitable mortar mixing machine of the rotating drum type. The period of machine mixing should be not less than 5 minutes after all the ingredients are introduced into the mixer.

Hand Mixing. The mixing should be done in a water-tight mortar box, and the ingredients should be mixed dry until the mass is uniform in color and homogeneous. The proper amount of water should then be added and the mixing continued until the consistency is uniform.

26. *Measuring Proportions.*—Methods of measurement of the proportions of water should be used which will secure separate uniform measurements at all times. All proportions stated should be by volume. A bag of cement (94 lbs. net) may be assumed to contain 1 cu. ft.; 40 lbs. may be assumed as the weight of 1 cu. ft. of hydrated lime. Hydrated lime

should be measured dry, and should not be measured nor added to the mortar in the form of putty.

27. *Retempering.*—Mortar which has begun to stiffen or take on its initial set should not be used.

28. *Consistency.*—Only sufficient water should be used to produce a good workable consistency. The less water, the better the quality of the mortar, within working limits.

Notes on Mixing.—The importance of proper and thorough mixing of the ingredients of the mortar cannot be too strongly emphasized. Machine mixing is in all cases to be recommended in preference to hand mixing. The use of hair or fiber is considered optional, and when used the method of incorporation should be such as to insure good distribution and freedom from clots. The maintenance of proper and uniform consistency should be insured by measurement of the water as well as of the other ingredients of the mortar. The question of retempering mortar is one which will bear further investigation. At the present time sufficient information is not available to warrant a change in the paragraph on retempering.

Mortar Coats

29. *Mortar.*—All coats should contain not less than 3 cu. ft. of fine aggregate to 1 sack of portland cement. If hydrated lime is used, it should not be in excess of one-fifth the volume of cement. Hair or fiber should be used in the scratch coat only on wood lath, or metal or wire lath which is applied over sheathing and is separated therefrom by furring deeper than ⅜".

30. *Application.*—The plastering should be carried on continually in one general direction without allowing the plaster to dry at the edge. If it is impossible to work the full width of the wall at one time, the joining should be at some natural division of the surface, such as a window or door.

The first coat should thoroughly cover the base on which it is applied and be well troweled to insure the best obtainable bond. Before the coat has set it should be heavily cross-scratched with a saw-toothed metal paddle or other suitable device to provide a strong mechanical key.

The second coat should be applied whenever possible on the day following the application of the scratch coat. The first coat should be dampened if necessary, but not saturated, before the second coat is applied. The second coat should be brought to a true and even surface by screeding at intervals not exceeding 5', and by constant use of straightening rod. When the second coat has stiffened sufficiently, it should be dry floated with a wood float and lightly and evenly cross-scratched to form a good mechanical bond for the finish coat. The day following the application of the second coat, and for not less than three days thereafter, the coat should be sprayed or wetted at frequent intervals and kept from drying out.

In back-plastered construction the backing coat should preferably be applied directly following the completion of the brown coat. The keys of the scratch coat should first be thoroughly dampened, and the backing coat then well troweled on to insure filling the spaces between the keys and thoroughly covering the back of the lath. The backing coat should provide a total thickness of plaster back of the lath of ⅝" or ¾", and should finish about ¼" back of the face of the studs.

The finish coat should be applied not less than a week after the application of the second coat. Methods of application will hereinafter be described under "finish."

31. *Two-Coat Work.*—Whenever two-coat work is required, the first coat should preferably be "doubled"; that is, as soon as the first coat is stiff enough it should be followed by a second application of mortar, and this should then be treated as described for the second coat under paragraph 30. The finish should be applied not less than a week after the application of the first coat.

32. *Drying Out.*—The finish coat should not be permitted to dry out rapidly, and adequate precaution should be taken, either by sprinkling frequently after the mortar is set hard enough to permit it, or by hanging wet burlap or similar material over the surface.

33. *Freezing.*—Stucco should not be applied when the temperature is below 32 degrees F., nor under any conditions such that ice or frost may form on the surface of the wall.

Notes on Mortar Coats.—Practice varies widely in the mixture and application of stuccoes. The use of hair, lime, and waterproofing materials, the variations in the mixtures for the different coats, the number and thickness of the coats, the intervals between the coats, the degree of wetting of the undercoats, and the precautions necessary in protecting the coats from too rapid drying, are details subject to question, and all will stand further investigation. However, the study of the experimental panels at the Bureau of Standards has yielded considerable information on some of these points.

One of the most important indications from these panels is that lean mixtures containing well-graded aggregate give better results than those commonly specified. Mixtures as lean as one part of cement to six or seven parts of graded aggregate have given excellent results in these tests. The committee is of the opinion that the volume change of rich mortars is accountable for much of the unsightly cracking of stuccoes, and that no mixture should be used in which the proportion of cement is greater than one part to three parts of fine aggregate.

The effect of hydrated lime in cement stucco has also been given considerable attention, and the conclusion which is forcing itself upon the committee is that hydrated lime does not improve the structure of the stucco, but by imparting better working quality to the mortar reduces the cost of application. On the other hand, there is evidence that not more than 20% of hydrated lime, by volume of the cement, should be added to cement stucco if the best results are to be obtained.

There seems to be no good reason for varying the composition of the different coats, but if a variation is to be specified, the scratch coat should logically be the strongest mixture, followed by a leaner brown coat and a still leaner finish. No greater mistake has ever been made in stucco application than the use of a strong brown coat over a weak base or a weak scratch coat. The not uncommon practice of applying a strong brown coat over a lime mortar scratch coat has been responsible for many stucco failures.

The suggestion that the finish coat should logically be leaner than the undercoats immediately brings up the waterproofing question. There are two fundamental points to be considered in this connection; first, that the lean coat is not necessarily lacking in density, and second, that the waterproofing problem in good cement stucco is not one of overcoming permeability, but rather of reducing absorption. The entire question hinges on absorption, and the evidence at hand indicates that a moderate degree of absorption is a much more preferable condition than a surface covered with craze and map cracks produced by the use of a too rich or wrongly manipulated finishing coat. ny waterproofing treatment that alters the natural texture and color of the stucco may be dismissed from consideration, and the merit of any integral waterproofing in stucco is exceedingly difficult to determine.

The question as to number and thickness of coats may be best answered by assuming that each coat of stucco has its own particular function. The scratch coat is the first applied, and its purpose is to form an intimate bond and a secure support for the body of the stucco. On metal lath it also serves as a protective coat, and it should therefore be strong and not too lean. The use of hair or fiber is of questionable value. Hair fiber should not be used when the space back of the lath is to be filled, and is probably not a necessary ingredient in any case. The committee at the present time would sanction its use only in scratch coats on wood lath, or on metal or wire lath that is to be back-plastered, or on metal or wire lath that is applied over furring deeper than ⅜". The thickness of the scratch coat should average about ¼" over the face of the lath.

The function of the second coat (commonly called the brown or straightening coat) is to establish a true and even finish. It forms the body of the stucco, and must fill the hollows and cover the humps of the scratch coat. For this reason an average thickness of ⅜" to ½" will usually be required. The brown and finish coats, or the scratch and brown coats, are sometimes combined in two-coat work, which is permissible when the base upon which the stucco is applied is fairly true and even, or when, on account of cost considerations, the best obtainable finish is not required. It is difficult, however, to obtain a satisfactory finish on a coat which runs ½" or more in thickness, since the tendency of a heavy coat to bag and slip is likely to produce an uneven surface.

The finish coat serves only a decorative purpose and has no structural value. Its function is solely to provide an attractive appearance, and any mixture or any method of application that may detract from the appearance or in any way injure its permanency should be avoided. Herein lies the argument for lean mixtures, which are more likely to be free from unsightly defects than rich mixtures, and are also more likely to improve

in appearance under the action of the weather. The finish coat should be as thin as possible consistent with covering capacity, and may vary from 1/8" to 3/8" in thickness, depending upon the type employed.

It is obvious from the foregoing that first-class stucco should be three-coat work, each coat serving its own particular purpose. The bond between the brown coat and the scratch coat needs to be strong in order to carry the weight of the body of the stucco, and for this reason it is now considered preferable to apply the brown coat the day following the application of the scratch coat. Except in dry or windy weather, little wetting of the scratch coat should be necessary when the brown coat is to follow within 24 hours. A slight degree of absorption or "suction" in the scratch coat is probably better than complete saturation, for the brown coat, as well as the others, is necessarily mixed with a larger quantity of water than it requires for maximum strength. The removal of a portion of this excess water by the suction of the undercoat not only improves the quality of the coat, but also insures a better bond by tending to draw the fine particles of the cement into the pores and interstices of the undercoat.

Whereas the interval between the brown coat and scratch coat, as recommended above, is relatively short, the interval before applying the finish coat should be as long as permissible under the conditions of the work. The reason for thus delaying the application of the finish is to enable the body of the stucco to obtain its initial shrinkage and a nearer approach to its final condition of strength and hardness, before being covered with the surface coat. The bond of the latter needs to be intimate rather than of maximum strength, and if the body of the stucco has been allowed to thoroughly set and harden, it may be assumed that there is less liability of volume changes in the under coats to disturb the finish coat. A week or more should elapse between the application of the brown and finish coats.

The finish coat should be applied over a damp, but not saturated, under coat, for excess water is likely to injure the bond seriously. Certain types of finish, such as the wet mixtures used for sand spraying or for the "spatter dash" finish, may preferably be applied to a fairly dry under coat, since suction must be depended upon to prevent streakiness and muddy appearance. The fact that finishes of this type applied in this manner may set and dry out with little strength is not serious; they gradually attain sufficient hardness with exposure to the weather.

Curing of the undercoats by sprinkling, and protection of finish coats against the sun, wind, rain and frost by means of tarpaulins are always to be recommended. This is not always feasible, however, and the architect should be content to specify and insist upon reasonable precautions. The application of cement stucco in freezing weather should be avoided, and in fact temperatures slightly above the freezing point may allow frost to form on a damp wall. The application of stucco under such conditions is likely to result in failure.

Finishes

34. *Stippled.*—The finishing coat should be troweled smooth with a metal trowel with as little rubbing as possible, and then should be lightly patted with a brush or broom straw to give an even, stippled surface.

35. *Sand Floated.*—The finishing coat, after being brought to a smooth, even surface, should be rubbed with a circular motion of a wood float with the addition of a little sand to slightly roughen the surface. This floating should be done when the mortar has partly hardened.

36. *Sand Sprayed.*—After the finishing coat has been brought to an even surface, it should be sprayed by means of a wide, long fiber brush—a whisk broom does very well—dipped into a creamy mixture of one part of cement to two or three parts sand, mixed fresh at least every 30 minutes, and kept well stirred. This coating should be thrown forcibly against the surface to be finished. This treatment should be applied while the finishing coat is still moist and before it has attained its early hardening—that is, within 3 to 5 hours. To obtain lighter shades add hydrated lime not to exceed 10% of the weight of the cement.

37. *Rough-Cast or Spatter Dash.*—After the finishing coat has been brought to a smooth, even surface with a wooden float, and before finally hardened, it should be uniformly coated with a mixture of cement to 3 cu. ft. of fine aggregate thrown forcibly against it to produce a rough surface of uniform texture when viewed from a distance of 20'. Special care should be taken to prevent the rapid drying out of this finish by thorough wetting down at intervals after stucco has hardened sufficiently to prevent injury.

38. *Applied Aggregate.*—After the finishing coat has been brought to a smooth, even surface, and before it has begun to harden, clean round pebbles, or other material as selected, not smaller than 1/4" or larger than 3/4", and previously wetted, should be thrown forcibly against the wall so as to embed themselves in the fresh mortar. They should be distributed uniformly over the mortar with a clean wood trowel, but no rubbing of the surface should be done after the pebbles are embedded.

39. *Exposed Aggregate.*—The finishing coat should be composed of an approved, selected coarse sand, crushed marble or granite, or other special material, in the proportion given for finishing coats, and within 24 hours after being applied and troweled to an even surface should be scrubbed with a stiff brush and water. In case the stucco is too hard, a solution of one part hydrochloric acid in four parts of water by volume can be used in place of water. After the aggregate particles have been uniformly exposed by scrubbing, particular care should be taken to remove all traces of the acid by thorough spraying with water from a hose.

40. *Mortar Colors.*—When it is required that any of the above finishes should be made with colored mortar, not more than 10% of the weight of Portland cement should be added to the mortar in the form of finely ground mineral coloring matter.

A predetermined weight of color should be added dry to each batch of dry fine aggregate before the cement is added. The color and fine aggregate should be mixed together and then the cement mixed in. The whole should be then thoroughly mixed dry by shoveling from one pile to another through a 1/4" mesh wire screen until the entire batch is of uniform color. Water should then be added to bring the mortar to a proper plastering consistency.

Notes on Finishes.—It is practically impossible to specify in written paragraphs the methods by which successful finishes are obtained. The quality of these depends upon the knowledge and skill of the plasterer, and the specification writer must content himself with a brief description of the several types. In the finishing of stuccoes, however, there are certain causes and effects which should be more generally recognized, a brief discussion of which will help to explain the limitations of the commonly used finishes and indicate the methods to be pursued in the attempt to develop better finishes.

In an earlier paragraph the defects resulting from the expansion and contraction of rich mortars has been referred to. The chance of such defects occurring must be greatest in the finish coat, which is directly exposed to the extremes of moisture and temperature variations. The hope of overcoming these defects lies mainly in the use of leaner mixtures, in which the tendency to movement is cut down as the proportion of cement is reduced. The problem, therefore, is to use less cement and at the same time retain the necessary density by improved gradation of the aggregates. Considerable success has already attended experiments along this line, and even better results are anticipated in the future.

All that may be accomplished in this direction, however, will hardly permit a smooth troweled finish to be used. This treatment produces a concentration of fine material at the surface which will almost inevitably develop fine cracks. In the course of time these cracks will collect soot and dirt and become conspicuous and unsightly. At best the smooth troweled finish is not to be recommended, and specifications should eliminate all reference to it.

The dash finishes—such as the sand spray, which is obtained by applying a mixture of sand, cement and water with a whisk broom or long fiber brush, or the spatter dash, which is usually a thin mortar containing coarse sand or stone screenings thrown from a paddle, or the rough-cast, which is a mixture of pebbles and cement grout thrown from a paddle or the back of a trowel—are all relatively rich in cement and all develop fine cracks to a very marked degree, but the rough texture of the surfaces masks these defects, and the type is therefore generally satisfactory and very widely used. The use of these finishes is in general to be recommended, unless the work is done by a stucco specialist, whose skill and experience qualifies him to execute the more difficult finishes to be discussed in the following paragraphs.

The chief objection to the dash finishes as above described is their rather cold, unbroken cement color, which may be relieved and improved to a considerable

extent by the judicious use of mineral pigments. Another means of varying the monotony of the natural grays and whites of the cement is by the use of the dry dash finishes in which clean pebbles or stone chips are thrown against the fresh mortar of the finishing coat while it is still soft. When the dry dash is well selected and the particles thickly and uniformly distributed over the surface, the finish thus obtained is pleasing and possesses decidedly more life and character than the wet dashes.

The sand-float finish deserves special consideration because it promises to be one of the most satisfactory finishes of the future. Due to the use of rich mixtures, the sand-float finish has usually developed defects similar to those experienced with the smooth troweled finishes, differing from the latter only in degree. Sand-floated stuccoes which have been covered with paint are to be found in every community, and this alone is sufficient evidence of unskillful manipulation of this finish and of the unsatisfactory results that have been obtained. In the experiments carried out at the Bureau of Standards the sand-float finish was found to be most satisfactory on mixtures containing not more than 1 part of portland cement to 4 parts of fine aggregate, and mixtures as rich as 1:3, with a small addition of hydrated lime, were satisfactory, as a rule, only when the final floating was delayed until the mortar had well stiffened. In this manner the concentration of fine material in the surface was prevented. This experience confirms the necessity for using leaner mixtures than have been specified heretofore, and for removing the cement from the surface by mechanical or other means, if the sand-float finish is to come into its own.

There is no hard and fast line between the sand-float finish and the exposed aggregate finish, since in the final water floating process of the former the aggregate is left sufficiently exposed to modify and improve the tone of the finished wall. When the sand-floated surface is further improved by an acid wash, the grains of the aggregate are cleanly exposed. It seems preferable in classification, however, to limit the exposed aggregate finishes to those in which coarser aggregates are employed than would be feasible for the sand-float finish. Thus defined, the exposed aggregate finish is obtained by the application of a coarser mortar containing carefully selected and graded aggregates, so that when the latter are exposed by brushing and cleaning the resulting texture resembles that of cast concrete which has been subjected to similar surface treatment. One of the members of the committee has recently developed a stucco of this type which has been applied to the Field House in East Potomac Park, Washington, D. C., over terra cotta tile. The color and texture of this finish, produced entirely by the aggregate, is the same as that of the concrete trim of the building. At the present time only the wings of this structure are completed, but the work thus far marks a distinct step in advance, not only in the treatment of the stucco, but also in the general adaptation of surface treated concrete to exacting architectural requirements.

In conclusion, the committee desires to state its conviction that while portland cement stucco may develop certain small defects which cannot always be guarded against, the product may be depended upon, if applied in accordance with the accompanying recommended practice, to be structurally sound, durable, and capable of giving satisfactory service, with little or no outlay for repairs or maintenance. The committee believes, however, that assurance of satisfactory results in stucco depends largely on the development of stucco specialists, experienced and skilled in this particular art, as distinguished from ordinary plastering. Intelligent and high class workmanship is so essential to good stucco that only those contractors who have had sufficient experience to establish their own confidence in the product, and who are willing to guarantee their work, should be employed for its application.

History and Development of Stucco[1]

By John B. Orr
Contractor, Miami, Florida

Artistic stucco! What great possibilities can be conjured up in these two words: Stucco, which is among the oldest, in some form or other, of man's early attempts at the artistic. With all the possibilities and, despite the fact that there can be found to this day portions of stucco in a good state of preservation after standing the wear of many centuries, there is no other form of building material that has fallen more into disrepute than stucco. This is especially so in the United States.

The causes can be traced largely to the slip-shod methods that have gradually crept into our building industry. Today, the main point of view or the achievement that is looked for is that a contractor shall complete in 60 days what should take three or four times longer. They take short cuts wherever they can; essentials that appear small in the successful completion of the work are sacrificed for time. The boy learning the business does not learn how good to do it, but how fast to do it. The view he gets as a successful craftsman is not to do better and try to improve on the specifications for the work, but just how much he can scamp and get away with. Some contractors govern their costs by these methods and we get the results so often noticeable in modern construction—competition in price instead of competition in value or good work. The good contractor who tries to figure at a price that will permit good work is in many cases forced out of business, leaving the field open to the cheaper man and his cheaper methods.

The old school craftsman had a different view; he tried to make his work a masterpiece just as much so as the artist did his on canvas. He wanted to look at it years afterward and be able to say, "I did that" or "I worked on that," and feel the pride that comes from viewing a masterpiece. I never will forget an early lesson I got during my apprenticeship, which I served under two master craftsmen, John Forbes, of Glasgow, Scotland, and his general manager, John Monroe, both of whom I look up to to this day as experts in their line of business. I was doing a piece of ornamental work in cement and was worried because an older apprentice was doing his faster. I commenced to scamp my work to gain speed; Mr. Monroe came on the scene and his sharp eye took in the situation. His cure was drastic; he took up a hammer and smashed my work, then proceeded to administer a lecture, namely, first to learn just how good I could do it and then speed in manipulation would follow. I took his advice to heart and found it to be good. I believe every form of encouragement and instruction should be given the craft

[1]From Copyrighted Proceedings American Concrete Institute, Vol. 13, 1917. Concrete, March, 1917, p. 98.

to get good work. In this convention is an exemplary method for the betterment of the work.

Ancient Stucco Materials

We find that stucco was used in building almost as soon as buildings were found to be necessary. It grew from the crude mud huts to the most artistic treatment of exteriors to be found in the old world today. Stucco is an Italian term usually applied in Italy to an exterior plastering, although we can trace it further back under a different name. The old Egyptians and the classical Greeks used a form of exterior plastering extensively; however, I have always looked upon Italy as the mother of the plastic art and responsible to a great extent for the artistic effects of exterior plastering generally known in this country as stucco. In Great Britain stucco is a somewhat indefinite term for various plastic mixtures. To great Robert Adam is due credit for the advancement of exterior stucco in Great Britain. He adopted it as a covering over houses built of brick and cobblestones and it was used extensively during his period.

I find that the Temple of Apollo at Dellos and even the first Parthenon under Aegis of Pallas was plastered with stucco. Vitruvius calls the exterior plastering Tectorum Opus. This was composed of three coats of lime and sand and three coats of lime and marble, the united thickness not being more than 1". The first coat was of common but very old lime and sand (lime that had been "soured" three or more years); when it was nearly dry a second and third coat was applied and left fairly straight. The work was then laid over with another two coats of lime and marble and finished with a coat of fine marble powder, this finish of marble powder being troweled into it before it was dry. The marble mortar was beaten to render it tough and plastic. The successive coats of marble mortar were troweled into each other before they were dry. The tectorum was then painted in brilliant colors while it was still fresh. In certain conditions the surface was then rubbed with wax and pure oil for the purpose of adding to the brilliancy and endurance of the colors. Slabs of this tectorum have been found and preserved from the ruins of Pompeii and Herculaneum and are in the Museum of Portici; specimens also from the same place are in the South Kensington Museum, London. It was found that some of this work was colored integrally, while in others it was colored by the use of a wash, which was applied over the surface while it was still fresh.

Early Attempts at Waterproofing Stucco

The early workers in stucco had each his different formula for treating the stucco to make it weatherproof. Pliny mentions fig juice as being used in exterior plaster; elm bark and hot barley water was mixed with the stucco used on Justinian's church of the Baptist, Constantinople.

Bullocks' blood was employed for this purpose in the mortar for Rochester Cathedral, England. Whites of eggs and strong mort of malt was used in the lime for Queen Eleanor's Cross, Charing Cross, London, in the year 1300. It is a historic fact that during the building of the Duke of Devonshire's house at Chiswick, the exterior of which was plastered with stucco, the surrounding district was impoverished for eggs and buttermilk to mix with the stucco. My mention of these different methods and treatments is to show the care and wide range of methods and mixtures that were used in the endeavor to make the stucco waterproof, and the difficulty that the old craftsman had to contend with in getting these results. Modern manufacture has overcome this to a large extent and has made the path of the stucco workers easier.

Stucco Not Fully Developed

It is a curious fact that the fountain of possibilities in modern stucco has hardly been tapped. I give for the reasons, first, fear of the permanency of the material; second, neglect by the architects in not studying the possibilities; third, the difficulties in getting the work executed owing to the ignorance of the craftsman in this branch of the plastic art. In reply to the first, anyone who has traveled or has gone into stucco historically can prove the permanency of the material before and after the introduction of portland cement as the binding material. By the introduction of portland cement and waterproofing compounds much has been done to simplify and make permanent the mixture. The danger in most cases to be overcome is in the manipulation. My greatest obstacle to overcome has been crazing or check cracking. This I have cured by what I believe to be the only sure method. The richer you get the mix, the more danger there is in check cracking; rapid drying, heat in cement, soft sand, these all help to cause check cracks. I have taken precautions against these dangers and have done what I could with the local materials that are obtainable in Miami. I had good results in some cases and in some others check cracks did appear despite the fact that I had made every effort to avoid them; I never yet had any stucco scale or fall off. My next attempt I made using an overwash of liquid stucco. This last method has proven very satisfactory, and I have jobs that are two years old on which there has been no appearance of crazing. In Florida we have several obstacles to overcome, although we do not have the freezing weather. We get a very poor sand that is impregnated to a certain extent with salt. The sand is not sharp enough. We have quick drying weather and strong sun heat, and I believe these to have been severe enough test to show that the stuff would not craze.

Color Possibilities

To the architect and designer, as a layman, I offer a few suggestions and criticisms. As a general rule they do not give enough study to the possibilities in color effect such as are to be seen in Europe, Cuba and other Latin countries. Then, in ornamentation they seem to forget that they are working in a very plastic material that lends itself to the fullest extent in obtaining lights and shadows. I believe that to get the full effects, relief work in stucco should have the appearance of being modeled in place with this material. It should not have hard lines and in no case should it have the appearance of carving as in stone. The work should retain all the touches of the modeling, these touches that give the sketchy effect which is lost in the carving in stone. In preparing the models the modeler should accentuate the detail and not attempt to smooth up the model. These markings, when brought out, all serve to make the work plastic and alive. It also helps in obtaining light and shade when colors are used as the finish. Even when the work is colored integrally these markings of the tool all stand out and bring out the work better to the eye when the buildings weather; in other words, he should not attempt to get in the clay any smoother work than he could get if he were modeling with stucco right in place instead of modeling in clay.

By proper manipulation of colors and attention to these details, great beauty can be obtained from work in low relief. On several jobs which I have under way at present I am using this method and getting what I believe to be good results. I am not attempting to confine the relief work to panels, but am using the walls as the background, getting an effect as if the work were actually modeled in stucco and keeping the relief work

very low and plastic. These are the touches that give the sketchy effect that is lost in the carving of stone. As a general rule it seems to be the practice of designers in stucco to copy stone; this, in my opinion, is entirely wrong. Stucco is a distinctive material and should be used as such. In my ornamental molding and relief work I use a combination of several colors (which match with the general color scheme of the exterior of the house) to bring out the effect and give light and shade. I use the darker tints in the background and work out the lighter tints in the high lights, blending all the tints by rubbing the one color into the other; by doing this you bring out all the plastic beauty of the modeling and give an artistic appearance to the whole scheme. My colors on stucco I bring out by the use of a wash of liquid stucco. I am quite enthusiastic about this color work and I think it wonderful the effects that can be obtained with its intelligent use.

A study in colors for the stucco of buildings is the work of an artist and should be given this care with due consideration to the surroundings in which the house is to be built. I possibly might be treading on the toes of manufacturers of cement paints when I say that I only use their materials when actually called for in some public buildings where the effect is to get something that will always look new and clean; in some cases, of course, this is very necessary, but for residence work we cannot do better than try to copy the early Italian stucco effect; that is, to get the results like stucco and not paint. There is something about the technical paints that give to the stucco an artificial appearance. I never like to see a residence that looks as though it had come out of a machine-made mold; I like to see the sketchy effect and also like to see the building weather properly, not stay one solid color, but get the soft effect that only a stucco can take on; a blend of several shades which come by age, and this is my objection to cement paint on residences; it looks artificial. Its use, in my opinion, as before stated, is limited to certain types of public buildings where the surrounding buildings, street and sidewalk have the tendency to harden the effect. Conditions like this call for an entirely different treatment than the residence that sets in grounds where one gets the benefits of the color effect of flowers and foliage. My idea in getting effect and tone in a residence is that a study of the whole scheme, including the landscape work, should be taken into consideration and let the residence become a part of the landscape in which it sets and not make it look like an obstacle that has been put in the way of the beauty of nature.

Cement Paints

In public buildings there is a big field for the stucco worker in producing the effects that are obtained by the use of terra cotta. Stucco can be made a formidable competitor of this material. It can be made permanent and has as wide a range of colors as polochrome terra cotta. When this is the result that is required, I use this method. In such work I use manufactured cement paints as a background, applied over a stucco surface for the color effect. I apply the stucco according to the accompanying specifications. When the stucco is thoroughly dry, I then apply a priming coat of a good cement paint, using the material thin and working it into the stucco surface with a brush, being careful not to use the material so thick as to spoil the texture of the surface. This texture should be a smooth sand finish. If the effect wanted is in a blend of several colors, my system is to cover the surface of the stucco with two coats of cement paint as mentioned above. I then mix up my blending materials in the form of a stain, using good mineral colors ground in oil, which I thin down with prepared oil. I apply this stain over my relief and ornamental work in the various tints desired. I then rub off the high lights and in general blend in the colors to give it the soft effects. On the plain surfaces I apply the stain in the color desired, then rub off as much as possible; this gives a very pleasing mottled effect that blends in with the under coating of cement paint and takes away the hard appearance. I have just completed a building on which I used in my relief work blue, golden buff and cream, and got a beautiful effect that resembles old Bisque China. On some of my work I get these effects by coloring integrally. It is then rubbed over with an oil preparation.

Applying Color in Liquid Stucco

On residence work my methods are entirely different. I apply the stucco as specified, getting the texture desired, preferably medium rough cast. In some cases I color the work integrally, a liquid form of the stucco of the same colors with a binder and hardener and waterproofing added. This material, when properly applied over a fairly rough texture, makes a fine finish, and when one becomes familiar with its working fine color effects are obtained. This liquid stucco is applied with a brush, like paint. The stucco surface, when finished, does not look like paint but retains the softness of the stucco with an unlimited range of color effects. On the ornaments and trim I use color effects with this wash in very much the same way as I specify for my treatment on public buildings, except that the material is a stucco composition. To get the shading great care and taste must be used. This liquid stucco coat should be applied before the stucco surface is dry, usually, wherever possible, a day after the stucco is finished. It then dries and sets along with the stucco and makes a good bond. Spraying with water helps to make the surface bind; use a very fine spray. It gets harder with age and, being of practically the same composition as stucco, it retains all the soft tints and makes a house very attractive, especially when the house has good surroundings. It seems to catch all the shadows and to change with different positions of the sun, reflecting the color of the surrounding foliage. It is this soft color effect that has made the homes of Italy and the south of France the mecca of the students of art. To me, the difference between this treatment and a surface that has been treated with some technical cement paint is like the difference between a cheap colored lithographic print and a painting. It retains the stucco surface, it keeps out check cracks and avoids the use of artificial paint, which is manufactured for this purpose but which, while curing check cracking, gives an artificial appearance and adds considerable to the cost.

The specifications which I give are taken from an article I wrote some time ago and which cover practically all conditions and treatments except possibly the texture for obtaining the Italian effects. The stucco in this case should not be perfectly straight except in the molding and trim. The molding and trim should be treated as specified, but the plain surfaces should give the appearance of stucco applied over cobblestone. No straight-edges should be used. The surface should be worked up to a condition with easy modulations, after it is partially set, go over it with the edge of a trowel, to roughen the surface slightly, being careful not to leave trowel marks. Apply over this the liquid stucco with the desired tints. I could give my method for mottling the color, but I am afraid it might be dangerous; the same applies to the texture. I did a very large stucco job here on which I have been working for two years. This was the effect desired. I had a lot of trouble in getting the texture; the plasterers would either make

it too rough or too smooth. I simply had to take a few of my men, train them into the method I wanted; then I chose the ones who seemed to get the idea of the effect desired. These few men I then used on the actual finishing of the work so as to insure the same texture throughout the entire work. I have another style of finish which gives a splendid effect and which is very popular. I bring up the work to the straightening coat as specified. For the finish I apply over this surface a very thin coat of cement and sand troweled with a good pressure; I then apply a dash with a whisk broom, being careful not to throw the whole contents of the broom in one place, but to spread it and get it with the texture about the size of peas, uniformly over the surface. I then apply over this the liquid stucco coating. A visit to Miami would show the results I have obtained.

Having thus given specifications for stucco work, it will be well to go over them for the benefit of the craftsman desiring to follow this method of procedure.

The cement, sand, etc., should be well mixed in its dry state and then tempered with water, to which the required amount of waterproofing material has been added. Following this the mixture should be worked to a good plastic condition. In making application, good pressure should be used in order to insure a good bond. In applying the straightening coat, do not use the darby float because the working of this tool is likely to drag the material and interfere with the bond. Rather use the straight edge. Use the rod with an up and down slanting motion to cut off the excessive material, and leave a rough surface, then scratch with a wire, being careful to scratch before the work is too hard.

After the straightening coat has been applied, the molded and ornamental members should then be worked out. It is common practice with many plasterers to add plaster of paris or some of the patent hard wall gypsum plasters to the material used for ornamental and run work. This is for the purpose of making the material set quickly, but is a wrong policy and should be avoided. The mechanic who has pride in the execution of his work will not adopt these methods if he knows that bad results will follow. Plaster of paris and patent hard wall plaster is diametrically the opposite of portland cement. The result is easy to foresee. The work blisters, scales and falls off, the set of the cement is killed and the material becomes like powder.

The reason that some mechanics use these methods is to gain speed in finishing the work. If, however, the molding and projections are worked together with a little system it will be found that finished results can be obtained with very little more time than by the use of foreign materials. All the moldings and other run work should have running strips set so that the craftsman can build up the various moldings gradually by giving each one as big a coat as will hang, doing the same to the others, and so on. By the time he has gotten to the last piece, he will find the first piece is ready to receive another coat. The running molds should be muffled, allowing about 1/8" for finish. After the moldings and run work are brought out to a complete finish, they should be gone over with floats, so as to insure the surface having the same texture as the rest of the wall.

In applying the finish coat, all splashes and pieces of projecting cement should be scraped off the straightening surface. The whole surface should then be saturated with clean water and it is at this point that the waterproofing plays such an important part. If the undercoat is waterproofed, it will hold the moisture of the finish coat and will allow the cement its own time to set. The ultimate adhesion, also the uniform working and strength of the finish coat, depends on this. If the moisture or "blood" of the cement is absorbed by the suction of the undercoat, the cement will become inert and will crack, peel or scale.

In working the finish coat, bring it to a true, straight surface by use of a straight-edge and darby float. This material should not be mixed too soft. A good method is to have one set of plasterers lay on the material and then have another set follow with rod and darby, working it carefully in all directions until it is brought to a full and straight surface. After the moisture has disappeared from the surface, gently scour it with a good cross-grain wood float. Care must be taken if dry spots should develop in floating not to throw water on the wall, but to dampen the float until the desired moisture is showing. Never stop the cement where the joint can be seen. Make all joinings at moldings or projections.

Next, after floating, the object is to be rid of the float marks. This is done by gently patting the surface with a float or by using a pad made of burlap. If the finish is accomplished by this method, good results will always be obtained.

When the work is in the direct rays of the sun, it should be protected with burlap, or oil duck cloth, hung up in the form of a shade. When the work is sufficiently resistive, it should be kept moist for at least 6 days.

Preservation of Stucco Buildings—We have on the market several forms of dampproof cement paint which make a good preservative of stucco. As I stated earlier in this article, I advise the use of this material on commercial and public buildings, especially those that are in a large manufacturing center. Such dampproof coatings protect stucco from the atmospheric chemical action caused by smoke, etc., and at the same time dampproof and protect the surface from hair cracks.

Wash Methods—For residence work I advocate the wash method, as it is cheap and can be renewed at very little expense. It weathers artistically with age. It has more advantages. Among these are the ease with which it can be applied and the wide scope of the colors that can be used. It serves as a good dampproofing mix and gives the opportunity for many artistic effects. It is the method I use to obtain the Italian and antique effects on stucco. The wash is composed of waterproofing, good mineral colors, cement and lime, with a binder and hardener added. This material has to be used carefully, and the stucco coat surface must be left in a condition that will form a good bond between the materials.

Here Are Mr. Orr's Stucco Specifications

Preparation of Surface—The entire surface is examined and all loose form scale removed from the surface, i. e., the scale is caused by cement adhering to forms from previous pours. (When the form is not entirely filled in one day's operations, a film of cement adheres to the form in places and sets when the pour is made. This film invariably forms a scale surface on the face of the concrete when the forms are removed.) The entire surface is gone over with a hand pick or an axe to roughen the surface; if brick, rake out joints. This is for the purpose of forming key for stucco. The surface to be brushed clean and thoroughly soaked, ready for application of stucco.

Proportions: Straightening Coat—The proportions of this coat shall consist of 4 parts of portland cement of approved brand to 12 parts of sand and 2 parts of hydrated lime. The above material to be thoroughly mixed dry, then tempered with water, to which has been added 3 parts of concentrated Truscon waterproofing paste to every 25 parts of water.

Finish Coat—The proportion of this coat shall consist of 5 parts of portland cement to 12 parts of sand and 15% of hydrated lime. (If white color is desired, use Medusa white cement and local white sand.) The above materials to be well

mixed dry, then tempered with water, to which has been added 1 part of the waterproofing paste to every 18 parts of water.

Application of Stucco: Straightening Coat—Care has to be taken that the surface is thoroughly saturated with water to insure perfect bond, then apply straightening coat. Bring the surface to a true and straight condition, using a traversing rod. (No darby float to be used on first coat.) Then scratch the surface with a wire or nail scratch. (This gives an under cut and insures good bond.)

Application of Finish Coat for Smooth Surface—If stipple, use same process, only stipple before set. If rough cast, dash the finish material with a broom. Thoroughly saturate the first coat surface with water until it presents a glaze appearance; when this glaze disappears, which will be in a few minutes, apply the finish mortar, which should not be too soft, and bring the surface to a true condition with darby float. When the mortar will permit, go over the surface with hand float, bringing to a true finish free of cat-faces or voids; the entire surface to be gone over with burlap or hand float and patted to take out float marks. No joints to be allowed in the work where they can be seen. The entire surface to present a uniform appearance in color and texture. Mortar should be applied as quickly as possible, and at all times protected from the sun.

Protection—Special care should be taken to avoid too rapid drying; if in the direct rays of the sun, the mortar shall be protected with burlap or wet canvas, and when sufficiently resistive, should be sprinkled with water for at least 6 days.

Stucco on Metal Lath—If stucco on metal lath, specify three-coat work with good fiber in first and second coats, waterproof in second and third coats.

Forming Molding—Cores for molding shall be formed of concrete by concrete contractor, allowing about 1" for finish. All molding to be run and finished with hand float to give same texture as rest of surface and to help bind the surface. When a condition arises where a heavy coat of mortar is necessary, a key for the mortar shall be formed by driving galvanized nails into the core.

Fig. 1—G. Gordon Massey Residence of Poured Concrete at Middleburg, Va.

Thin Stucco Finish on Concrete Walls

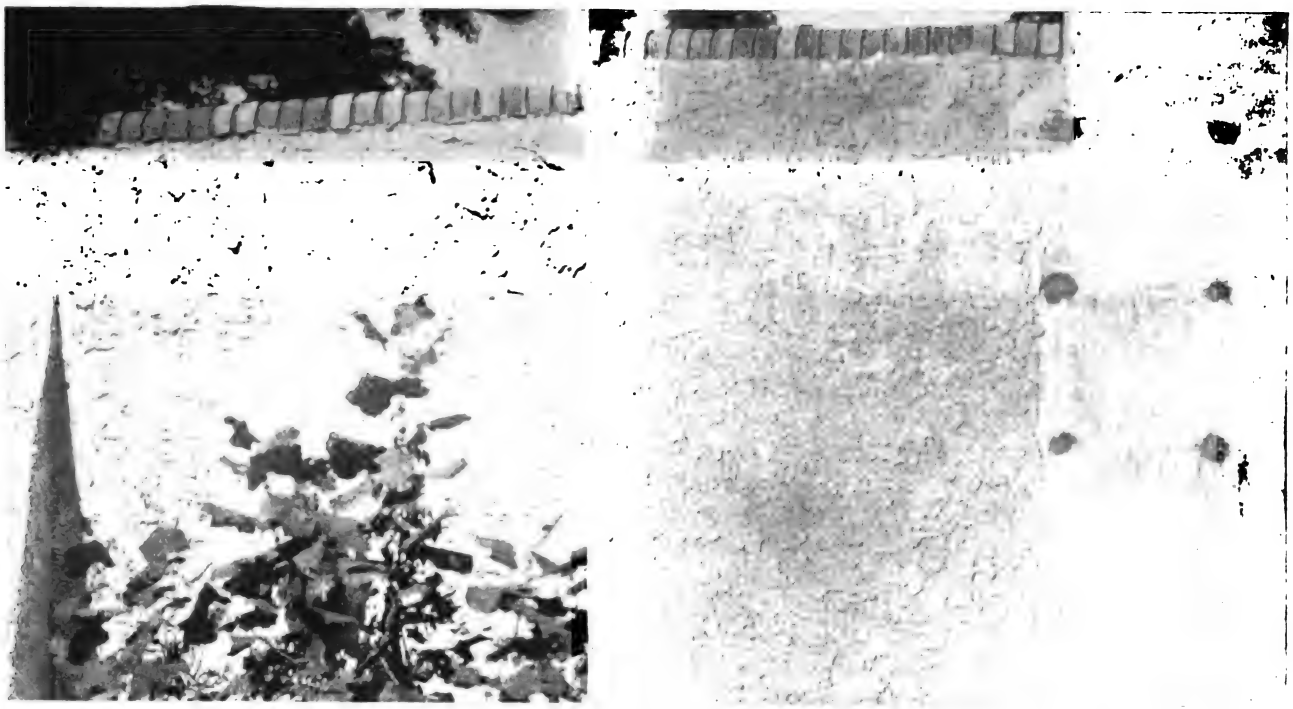
(Contributed)

In the mind of even the layman who has watched the construction of a house of reinforced concrete, there is no question of concrete's superiority as a structural material, but we must recognize the fact that if the reinforced concrete house is to take the place which it deserves in the building world a radical change must be made in its appearance and exterior treatment.

The demand is for a finished, workmanlike surface as it comes from the forms, and it must be acknowledged frankly that with the usual methods this has seemed almost unattainable.

We can theorize on the artistic side and argue that the exposed aggregate is the true concrete surface, or we may satisfy ourselves with the reasoning that the form marks should remain and show, being natural to this way of building, or we may go further and use a tooled surface. But while these wall finishes may be excellent

[1]From Concrete, Jan., 1915, p. 24.



FIGS. 2 AND 3—A GARDEN WALL OF CONCRETE WITH SLAP-DASH STUCCO FINISH AND AT THE RIGHT EGG-SHELL FINISH AND A SECTION OF UNFINISHED WALL—THE STUCCO IS ¼" THICK (AVERAGE) AND COST 15 CTS. PER SQ. YD. FOR MATERIAL AND LABOR

A feature of this finish and in practically all of the other stucco finishes put on under Mr. Haga's direction is in the fact that workmen are not permitted to "fuss" with their work. It has been very hard to get them to press on the stucco firmly with one free stroke and then *let it alone.* But that is what is done on nearly all of the Haga work. In Fig. 4 the holes where the spacing rods for the steel form sections were driven out have been pointed and the surface is ready for stucco.

for some types of houses, I believe that all builders who have tried these methods of finish know the difficulties encountered and have often themselves been disappointed in the results obtained.

Stucco and rough-cast surfaces seem especially suited to concrete buildings and offer great artistic possibilities. It is a common saying in these times that while a man is saying that a thing cannot be done he is quite likely to be interrupted by another man doing it, and this is true in stucco over concrete, and "the man who made it stick" is none other than a Virginia builder operating in a rural section of Landam Co., 12 miles back from the railroad.

The work of C. H. Haga is illustrated and described on other pages, but up to the time of his death early in 1915 his work constantly increased in scope and, while he started in the construction of small cottages and farm buildings, the Haga-built houses are established as a standard for the entire section and sought for by rich and poor alike, not because they are cheap, but because they were the best that money could buy. The fine exterior finish and consequent attractive appearance are not the least of the reasons for this phenomenal success.

To obtain straight, smooth walls, as well as for economy in erection, Mr. Haga has used on all this work one of the standard makes of pressed steel wall forms, equipment which he has already used over hundreds of times without apparent damage.

On the first buildings he was careful to have the stucco applied while the walls were green, but in the later buildings he has found this precaution unnecessary and often the stucco has not been put on until months after the walls were up. At first the wall was roughened to give bond, but this was also found to be unnecessary, and the finish was applied on the smooth surface, just as left by the steel forms. Work of this sort has been done at all seasons of the year except in the dead of winter.

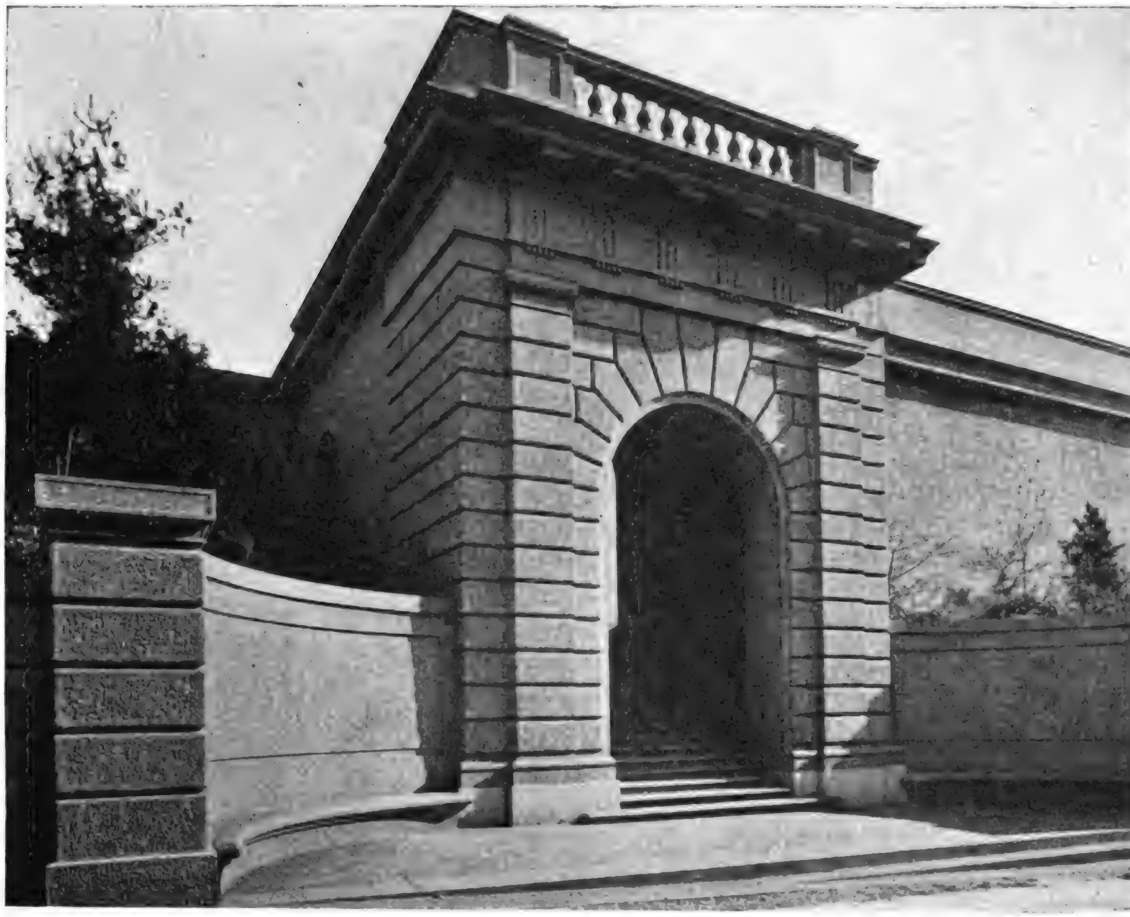
To test the bond the writer has tried to remove the stucco in several places on the various buildings, but invariably the chisel takes a part of the concrete off with the finish, showing a perfect bond. It is hard to account for this except by the fact that the coat is put on only ⅛" to ¼" thick and does not act in the same way as a heavy thickness of stucco.

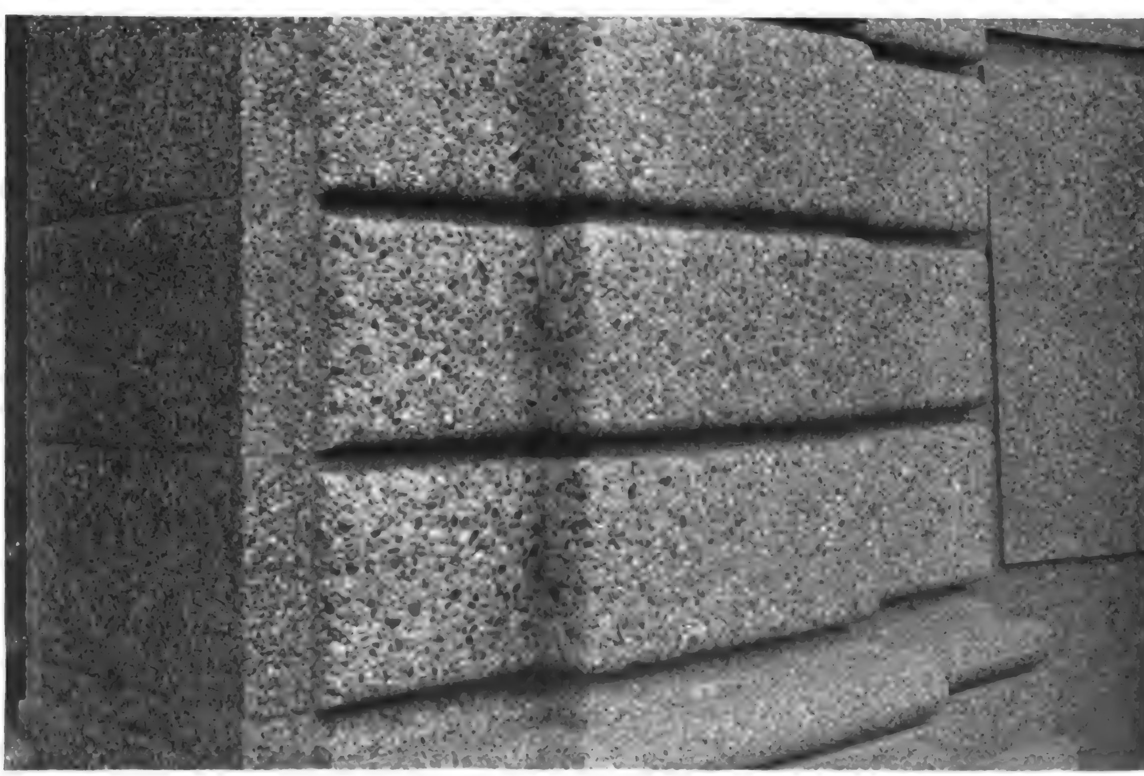
First, the wall is thoroughly drenched about an hour before the work is applied and again immediately before the work is started. White or gray portland cement is used with clean sand or stone dust. It is applied with a steel trowel, but great care is taken not to touch the work after the first stroke. This gives that free, almost careless appearance so characteristic of the best Italian stucco finish, and the walls have a uniform, workmanlike appearance, yet show great variety, as no two spots are alike.

The stucco mix is 1 part cement to 1 part sand or crushed stone, with 10% by volume of hydrated lime added. In warm weather the stucco is sprinkled and kept damp until it has set up quite hard. Coloring matter, when desired, is mixed in the mass, but enough is mixed dry for an entire side before the work is started. The work is done by plasterers. The cost of the material with white cement is a trifle less than 6 cts. per sq. yd., and the labor cost is about 9 cts. per sq. yd., so that the total cost of this attractive finish has averaged only 15 cts. per sq. yd.

One of the advantages of the rough surface is that any slight imperfections in the wall or stucco do not show, and in one of the buildings an extra rich mix was used in the stucco and it was applied in hot weather.

Much of the work on the various buildings has now stood perfectly for nearly three years, and shows no defects and seems to be as hard and permanent as the wall itself.





FIGS. 1 AND 2—GENERAL AND DETAIL VIEWS OF ENTRANCE TO MERIDIAN HILL PARK, WASHINGTON, D. C., SHOWING EXPOSED AGGREGATE SURFACES

New Developments in Surface Treated Concrete and Stucco[1]

By J. C. Pearson[2] and J. J. Earley[3]

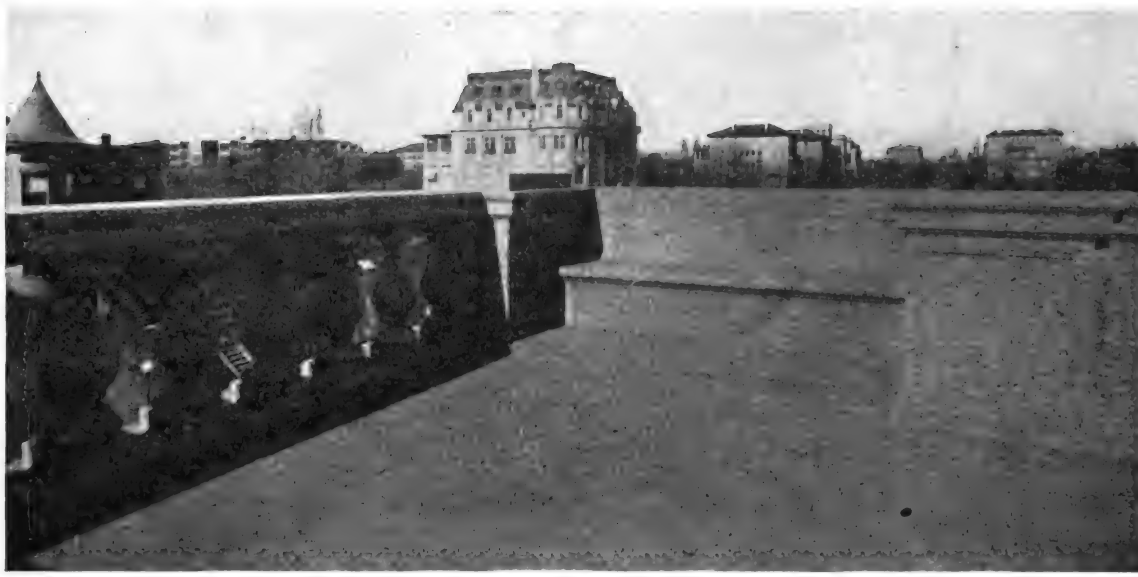


Fig. 3—Precast Concrete Work at Meridian Hill Park

Studies of experimental stucco panels at the Bureau of Standards led to the general conclusion that by adherence to well-established practice, structurally sound and durable stucco could be secured, but that a great deal could be, or ought to be, done to improve its appearance. Crazing and map cracking are common to most stuccos, and are especially objectionable on surfaces of fine texture; the monotony of the cold gray cement color is objectionable, and is only partially relieved by the use of white cement and mortar colors; and finally, the muddy appearance (due to cement, or cement and pigment, being too much in evidence) is objectionable from an artistic standpoint.

Consideration of these matters suggested at once the use of less cement, and it became evident that by effort in this direction improvement in appearance might be obtained. The apparently insurmountable obstacle to this departure from usual practice was, of course, the lack of plasticity in the leaner mixtures. Various methods of overcoming this difficulty were considered, and some experiments were made which indicated that a real improvement might be obtained by substituting fine inert material for a portion of the cement. The easiest way to accomplish this result seemed to be by using blended cements, that is, normal cement ground with a certain percentage of sand, stone screenings, or other suitable materials. These experiments were never carried very far, however, for it did not seem possible that any method which might be devised for retaining plasticity could bring about the desired result, viz., the elimination of all objectionable features mentioned above.

Serious as was this lack of plasticity in the lean stucco mixtures, it was after all something that could be overcome by *work*. This was demonstrated by the fact that mixtures as lean as one part cement to six parts of stone screenings were applied on some of the Bureau of Standard panels with excellent results. But the improvement in these panels as compared with some of the easier working combinations did not seem great enough to justify the increased cost of application. The question finally arose whether by careful attention to gradation of the aggregates this improvement in appearance might not be so enhanced that the cost would be a secondary consideration.

This idea came from the fact that Mr. Earley had succeeded in making complicated casts of concrete from specially graded aggregates in such manner that a very large percentage of the area of the treated surface (first

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[1]Abstract of paper from Copyright Proceedings American Concrete Institute, Vol. 16, 1920. Concrete, March 1920.

[2]United States Bureau of Standards, Washington, D. C.
[3]Sculptor, Washington, D. C.

[Author's Note.—The joint authors of this paper have been closely associated by their membership on the Advisory Committee of the Bureau of Standards Stucco Investigation, and on the Committee on Treatment of Concrete Surfaces of the American Concrete Institute. Both residing in Washington, they have had an unusual opportunity to study and discuss together the results obtained from the experimental work of the Bureau in concrete and stucco, as well as those from Mr. Earley's work in connection with his contracting business. These discussions often led to the consideration of possibilities somewhat beyond the range of established practice, and, in fact, beyond the limitations of established theories relating to the gradation and proportioning of the ingredients of mortar and concrete. It was therefore natural that ideas were conceived which were too visionary to be of use to any committee, but nevertheless deemd worthy of further investigation on the writers' own account. If these ideas proved to have no value, no one would be the loser; if they did amount to anything, the results would be a contribution to our knowledge of stucco and concrete.]

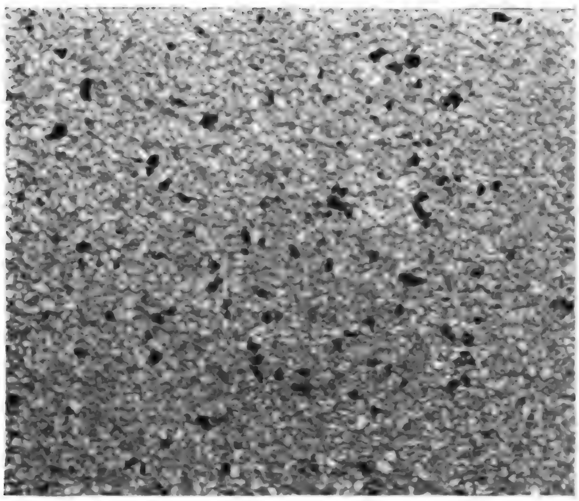
FIG. 4—GATE POSTS AT ENTRANCE TO UNITED STATES NAVAL HOSPITAL, WASHINGTON—AGGREGATE POTOMAC RIVER GRAVEL

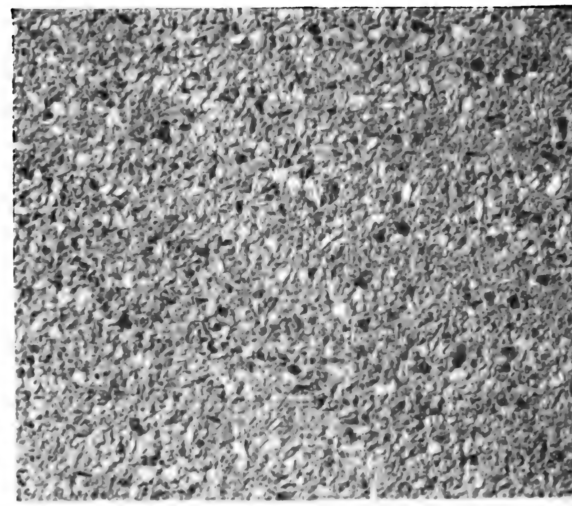
wire-brushed and then washed) was aggregate, and a very small percentage of cement. Possibly due in part to the higher reflecting power of the surfaces of the exposed aggregates, the color of the concrete surfaces thus produced was determined almost wholly by the color of the aggregates, and only very slightly affected by the cement itself. A most convincing demonstration of this fact was obtained by constructing two concrete slabs containing exactly the same proportions of specially graded aggregate, the one being mixed with gray cement, the other with white cement. After the surface treatment of brushing and washing had been applied, only an expert could have determined which slab contained the gray cement and which the white.

To digress still further for a moment, this method of obtaining permanent and very pleasing colors in concrete surfaces is such an important item in the development of the processes here described, that it is worthy of fuller explanation. Before color in concrete surfaces can be under artistic control, a technique must be developed which has for its medium the elements of the concrete itself. Although in problems involving appearance aggregate is by reason of its greater bulk the major element, and cement the minor, it is, nevertheless, the color of the cement which is the natural color of normal concrete. The reason for this is that the cement is finely ground and deposits itself, paint-like, over the surfaces of the aggregates and colors the whole mass.

If, therefore, concrete is to receive its color from the cement paste, variation must be obtained by the addition of pigments to the cement following the well-established

FIG. 5—VESTIBULE OF PRIVATE RESIDENCE, WASHINGTON





FIGS. 6 AND 7—TWO CLOSE-UPS OF CONCRETE SURFACES BY EARLEY-PEARSON METHODS

practice of mixing paints; but if the aggregate is to be the source of color, the concrete must be so designed and manipulated as to deposit in the surface the greatest possible amount of aggregate.

Any great degree of success can hardly be expected in coloring concrete through the cement. The hcoice of colors is restricted by chemical reaction with the cement which causes them to fade or change; depth of color is restricted by strength requirements of the concrete, which limits very closely the amount of pigment which may be added to the cement. Therefore, with the choice of color limited by one requirement and the depth of color by another, the cement itself must remain dominant.

On the other hand, in coloring concrete through the aggregate, all such restrictions are removed, and colors may be obtained from white to black through all the range of possible aggregates.

An examination of drawings done in hard pastelles and of paintings of the impressionist school suggests a technique in coloring which is peculiarly adaptable to the coloring of concrete by means of aggregate. In the pastelles tones are produced by hatching and cross-hatching with lines of pure color without blending on the surface of the drawing, in the paintings by spotting with pure colors one beside the other, and without blending. In both cases the tones are effected by the blending of the light rays reflected from the picture to the observer. Wonderful depth and clarity of tone are characteristics of this school of coloring, and in it are to be found a great deal of exact knowledge and valuable precedent. When this knowledge is translated in terms of concrete aggregates, it is obvious that if the aggregates are carefully selected and carefully placed, all the elements are present for the successful coloring of concrete surfaces. The results obtained in practice bear out the theory given above, and there is every reason to believe that the aggregate is the proper source of color for concrete.

Hence it was a most important conception that a similar result might be obtained with stucco. The success of this depended, first, upon securing a suitable gradation of the stucco aggregate, and, second, upon being able to apply such a mixture, once it were satisfactorily compounded. It was known at the outset that these mixtures would be harsh, therefore plasticity no longer played any part in the calculations.

The laboratory program was fairly simple. The plan consisted simply in working first with concrete mixes in miniature, in which the sizes of cement particles, sand particles and coarse aggregate particles were reduced from the normal sizes in the ratio of about 1:10, this being taken as the approximate ratio of the size of particles passing a No. 8 sieve, to pebbles 1" in diameter. It was assumed that the density of such mixes would depend mainly on relative sizes of the component particles, with due allowance for the water content. If these mixes appeared to be satisfactory for the purpose, it was assumed that any reduction within the 1:10 ratio would also be satisfactory, and the actual reduction to be employed in compounding any given stucco mixture of this type would be as slight as the requirements of

FIG. 8—ENTRANCE TO VESTIBULE OF PRIVATE RESIDENCE—COLOR ALMOST WHITE, WITH OCCASIONAL SPOT OF BROWN (FIG. 5)

texture and the difficulties of application would permit. To make a long story short, these experiments in the laboratory with the miniature concretes were very successful. Not the least important part of the laboratory work was the microscopic examination of the structures of these little concretes, which yielded many valuable suggestions for the gradation in size of particles, and for the proper proportions of the various sizes, to yield the desired effects in the treated surfaces.

The first attempt to apply the new product to a vertical wall was not wholly discouraging. Small areas were treated successfully, and eventually a terra cotta tile pent house on one of the new laboratories of the Bureau of Standards was coated with the exposed aggregate stucco. This example was the forerunner of the work illustrated in this paper, and while it is not as free from imperfections as the more recent work, it has attracted most favorable notice. Fortunately the mechanics who were selected for this work developed a real interest in the new type of finish, and subsequently a pride in the results of their work, which made for very rapid progress in the development of the methods of application and treatment. New requirements in thoroughness of mixing, consistency, and control of the absorption of the undercoats were met, and other improvements in the general process were gradually introduced as essential parts of the routine. Not all of the problems have been solved, but there has been very gratifying progress in the comparatively short time that the new stucco has been applied commercially.

The illustrations accompanying this paper have been selected as typical of Mr. Earley's work in the vicinity of Washington, D. C. They are arranged in nearly chronological order and show the gradual improvement that is being made as experience accumulates.

Figs. 1, 2 and 3 are views of the concrete work at Meridian Hill Park, Washington, D. C. Fig. 1 is a general view of one of the main entrances, the construction of which was described in the Proceedings of the American Concrete Institute, in 1918. Fig. 2 is a detail of the surface. Fig. 3 is a view of the upper level of the entrance shown in Fig. 1. The balustrade, seat and planting box are of precast concrete, containing Potomac River gravel as coarse aggregate; the concrete tile are fabricated from black trap rock. The detail of the entrance shown in Fig. 3 illustrates the use of different textures for achitectural scale, but with no variation in color. The aggregate is Potomac River gravel without additions or modification of any sort.

Fig. 4 is a view of the gate posts at the entrance to the grounds of the U. S. Naval Hospital. The aggregate is Potomac River gravel, but slightly modified to obtain a color harmonizing with that of the buildings in the background.

Fig. 5 is an interior view of the Cafe St. Mark's, Washington. The architectural treatment is such as to give one the impression that he is lunching in a formal garden, whence the cafe is sometimes referred to as the "Outside Inn." The walls are of exposed aggregate stucco, on metal lath, the color and texture matching that of the precast concrete urns. This is notable as the first commercial application of this type of stucco.

Fig. 6 shows the surface of the Potomac Park Field House, Washington. The work was done with Potomac river gravel. The surface treatment is applied to the undercuts as well as to the more exposed portions. Attention is called to the close disposition of the larger pieces of aggregate, and the evenness of the texture.

Fig. 7 is a view of the concrete work at Fort Lincoln Cemetery, as yet uncompleted. [The surface shown on the cover of this magazine, beginning with the January issue, 1920, is from a photograph of that surface. A view of the building was shown in the January issue, also. —Editor.] The color of the aggregate is such that from a moderate distance the structure resembles cut granite, but it is in no sense an imitation of granite. It is interesting in showing the remarkable proximity of the stucco aggregate. In comparison with Fig. 6, this detail shows improvement in control and workmanship.

Fig. 8 is a detail view of the vestibule of a private residence. This has recently been completed, and is a very interesting combination of precast work, monolithic concrete, and stucco. The color is nearly white, with an occasional spot of brown, the texture is characteristic of concrete and not of stone, and both color and texture are uniform throughout.

The writers believe that the work here described shows progress in the development of concrete and stucco as materials worthy of a place in the highest type of buildings or structures. It is to be noted especially that none of this work is an imitation of stone. Close inspection shows at a glance that it is concrete, with textures that vary widely, but always characteristic of concrete. Furthermore, the material may be cast in any form the architect may desire, with all details complete; no cutting, tooling, or dressing is required other than the prescribed treatment of cleanly exposing the aggregate. Finally, the material provides a medium for the expression of color in infinitely greater variety than that which obtains in the natural building stones.

In conclusion, the writers would add a word about stucco. The new type of exposed aggregate finish cannot fail to arouse new interest in stucco, as a product, regardless of the nature and treatment of the finishing coat. The product should be more widely used, and, the reason it is not more widely used is that it has too often been applied by contractors or mechanics who consider it only as an outside plaster. This paper has attempted to convey the impression that cement stucco is more like concrete than plaster, and that plasticity is not essential. The point the writers wish to emphasize is that the art of applying durable stucco is very different from the art of plastering, and in their opinion, stucco will take the place it deserves among building products only when this fact is generally recognized.

A House Built Like a Battleship

By Wharton Clay
Commissioner, Associated Metal Lath Manufacturers
Chicago

Naval engineers have, out of necessity, been guided by economy in the protection of the modern ship from the speeding projectiles of the enemy. Gunners are taught to aim at the water line amidship in order to puncture if possible a point where the vitals of the vessel are located.

Most insistant and crafty is fire, the enemy of the home. When architect John Read Fugard, a member of the American Institute of Architects and of the firm of Fugard & Knapp, Chicago, designed a home for himself, he was keenly alive to the fire hazard. A specialist in apartment and hotel buildings of the most modern fireproof construction, he is fully aware of the great need for adequate fire protection of all inhabited buildings.

He is a firm believer in fire protection at a cost commensurate with the lessened risk of suburban architecture. Where he feels he must build his floors and partitions of wood for the sake of economy, he realizes that the wood in some parts of the house must have a protection that would prevent any blaze from setting the wood on fire for over an hour. Realizing fully the splendid results of the naval engineers' methods of protection, he decided on a similar means of economical fireprofing.

Where the battleship is protected by armor from high powered shells that are aimed at certain vulnerable points, the home must, of necessity, be protected with fire resistive materials where the fires are most likely to start. The naval engineer knows from bitter experience that the portions of the ship adjacent to the engines and boilers must be heavily armored to prevent explosion if hit there. On the other hand, the architect knows that possiblity of fire is reduced if the part of the home over the heating plant is plastered over metal lath. The destruction of an ammunition hoist means the silencing of a battery of great guns. In the home, a fire destroying the staircase prevents the firemen reaching the upper story, and imperils the lives of the occupants, especially in a night fire.

In the battleship, the prow, the midship portion, the conning tower, the gun turrets and barbettes are specially protected. Their vulnerability to projectiles means probable destruction of the ship. In the home, all bearing partitions and stud exterior walls, the ceilings under inhabitated floors, especially over heating plants and coal bins, at chimney breasts, around flues and back of kitchen ranges, stair walls and under stairs, need special protection. They also are vulnerable to fire and need special attention.

It does not require volumes of theory to solve the problem of adequate fire protection. The cause and effect of the greatest of national wastes is too vivid to require anything but sound reasoning to secure satisfactory results. Our shrinking forests cry out to the need of proper fire protection of combustible structural members in residential buildings. 999 out of every 1,000 homes are constructed largely of wood. No matter what the exterior may be, the interior structural members are of wood and vulnerable to the insidious interior fire unless protected in places where the fire starts. 95% of all fires start within the home. That in itself should make every prospective house owner look to the ultimate safety of his investment.

It is not an idle jest to say that building with fire resistive materials is necessary. Every year an equivalent of 11,000 $6,000 homes is reduced to ashes. Think of it! A row of beautiful homes, if built on 50 lots on each side of a street 52 miles long, in ruins. Fire and life insurance are extremely valuable, but they cannot bring back the natural resources that are destroyed or cherished companionships that are lost.

The architect makes the home practically invulnerable to fire and increases the cost of the home but 1%.

For appearance, and as a matter of economy, Architect Fugard specified portland cement stucco, back-plastered on metal lath for the exterior walls. Metal lath was used as a base for plastering over the vulnerable points. In portions of the house where little or no fire hazard exists, ordinary lath was used. In this way, the cost of the entire structure was kept at an extremely reasonable figure.

While this particular house, as built, may be a pioneer, in its unique application of fire prevention methods, it is in nowise an experiment as far as the construction

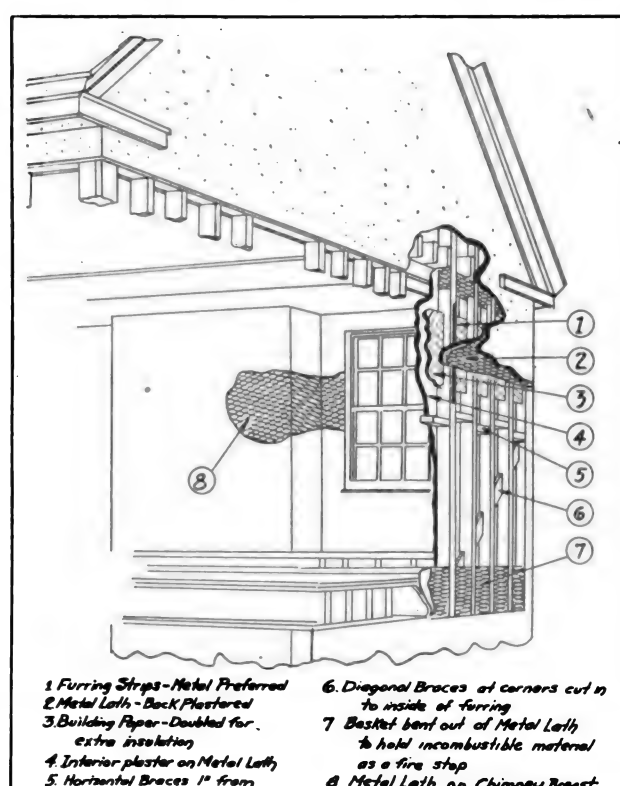


Fig. 1—Back Plastered Metal Lath Construction

[1]Concrete, August, 1920.

Fig. 2—Plans of the Fugard Back Plastered Stucco House in Evanston

details are concerned. As noted above, it is of back plastered metal lath construction and in many other cases the recommended practices for portland cement stucco of the American Concrete Institute were followed by Mr. Fugard.

Wide eaves were provided so that the vertical stucco walls are protected from the weather as much as possible. Proper window drips and the elimination of any horizontal courses of stucco are likewise little details which bespeak of the care with which the architect undertook to get a weather-proof exterior finish for the stucco.

Diagonal corner braces were used in the exterior walls, a 1 x 6 being let into the studding on the inner side. Horizontal bracing was also used. This method of construction allowed for complete elimination of the sheathing and was consequently quite economical. Back plastered stucco is a type of construction which is proving its worth day in and out, in rigorous tests of all kinds. Although it has been used for years in New England, where it has successfully stood the ravages of extreme climate, its worth was not generally accredited until the Bureau of Standards tests were made public in 1917. The government spent six years in obtaining authoritative data on exterior walls. Out of 56 panels tested by the Bureau, the back plastered metal lath type was the only one receiving a perfect rating.

The Bureau of Standards furthermore developed some interesting facts regarding sheathed construction. It was found that sheathing was not necessary for stiffness in the walls, and that the additional layer of wood between stud and stucco tended to produce cracks. It was also discovered that diagonal sheathing is even worse than horizontal sheathing, as it sets up strains which form more cracks in the stucco than when horizontal sheathing is used.

Estimating the cost of sheathing at $100 per thousand board feet in place, a saving of $250 is effected by its elimination in this particular house and the consequent economy of the back plastered type of construction becomes apparent.

The Bureau of Standards results have been checked a number of times by auxiliary experiments. Only a few weeks ago, tests on the distortion of wall panels in Omaha showed the back plastered form of construction to be much stiffer than the sheathed type. The reason for it is, of course, quite obvious. In the back plastered type of wall you have a monolithic reinforced concrete slab at least 1¼″ in thickness. Just enough stucco is placed back of the plaster keys to protect thoroughly the metal lath strands and to imbed it sufficiently so that every bit of the steel will take its part of the tensile stresses in the slab.

The question of insulation of exterior walls for this house built like a battleship was also based on the results of authoritative investigations.

A series of tests but recently completed at the Armour Institute of Technology showed that back plastered metal lath construction with common building paper doubled and set between the studs, using strips of wood for cleats, was cooler in summer and warmer in winter than ordinary frame construction with building paper between sheathing and siding, or stucco, using wood sheathing covered with building paper. The simple, inexpensive process of doubling common building paper was found to be a better insulator than thicker, more expensive insulating paper. The secret apparently lies in the doubling of the paper, the additional air space, though infinitesimal in size, acting as an insulator of high order.

To carry out fully the American Concrete Institute recommendations concerning the firestopping of a frame structure, Architect Fugard specified a basket bent out of metal lath to occupy the spaces between the studs at the juncture of floor joists and walls. This was filled with cement mortar from the ceiling level to four inches above the floor level.

In every house in which back plastered metal lath construction is used, the question of furring is brought up—½″ crimped furring, galvanized or painted, or 3/16″ pencil rods should be used unless a self-furring lath is provided with which furring can be omitted. The furring should always be attached vertically, directly along the center line of each stud, and fastened thereto with 6d nails or 1¼″ 14-gauge staple by fastening every 6″. Over this furring the sheets of lath are placed—lengthways, being horizontal. The lathing is started at the top and carried down, the bottom sheet lapping over the one above, and fastened by nailing or stapling every 6″. Care should be taken to see that the penetration is at least ⅞″ in the wood.

In application of stucco, the recommended practice of the American Concrete Institute should be carefully followed, as good workmanship is essential to first-class results in stucco work. Too much care cannot be exercised in the selection of competent contractors and good workmen if permanent satisfaction is desired.

Architect Fugard did not allow the unique system of fireproofing or modern construction methods to interfere with the comfort of his home. As seen from the plan, the house is both spacious and homelike.

Overcoating An Old Frame House[1]

Sometimes the owner finds such pleasant associations in the "old home" or its immediate surroundings that he is unwilling to rebuild or even to build on another site. By putting a stucco covering on the outside, he can, however, preserve and beautify a place at a reasonable outlay.

This is exactly what has been done in the case of the home of Louis N. Stix, Cincinnati, O., before-and-after illustrations of which are presented on page 28, and construction views on this page.

Mr. Stix's house had been painted two years previously, but it again required painting, and after receiving bids from the concern which had previously done this work, he was surprised to learn the increase in cost as compared with former bids. He was advised to sell the house and build of more modern and fireproof materials, but Mr. Stix was attached to the immediate surroundings and grounds of his home, in which were old shade trees, fruit trees, and ponds, which represented an old association, and besides, the interior of the house contained every modern comfort. So it would have been altogether a sacrifice to break away from the old home. An architect then advised stuccoing the house, after making a few alterations, as the solution of the difficulty, and this was done.

Method Used

Very little preliminary work in addition to alterations was necessary before putting on the stucco coating. None of the lap-siding of the old structure was removed, and the tar paper was tacked directly on top of it; then ¼" furring strips were nailed on, and after this Steelcrete floor binder was nailed and stapled on, the latter being a very stiff metal with a mesh 3¼" x 1½" in size. An electric Hodges stucco machine was then used to embed the binder in stucco to a depth of ¾" in a one-coat job. As the base coat was being placed, a plasterer followed and rough-floated the coat, so as to prepare it for the spatter dash finish.

After 24 hours the base stucco was wet down and the dash finish was added by the machine. It would have been much more difficult to have embedded such a large metal mesh by hand-applied stucco, and perhaps the only possible way to have accomplished this would have been by applying two or even three coats.

Materials and Cost

The materials used in the stucco machine for putting on the surface were Atlas portland cement, both white and gray, washed bank sand, and crushed marble passing a No. 8 screen. In addition, hydrated lime, equal to about 10% by volume, was added to the mixture.

The base coat, ¾" thick, was applied at an average rate of 18 sq. yds. per hour, the labor cost per sq. yd. for this coat being about 22c.

A force of five men was required for this operation, their cost being as in the following table:

No. of Men	Duty	Pay per hour
1	Operate machine	$1.00
1	Feed machine	.65
1	Float surface	1.00
1	Mix mortar	.65
1	Carry mortar	.65
	Total cost per hr.	$3.95

[1]Concrete, January, 1920.

Fig. 1 (Above)—Projecting Stucco Overhead Against the Porch Ceiling

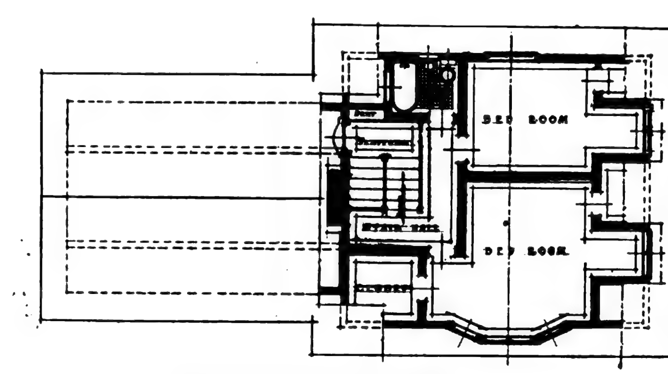
The dash finish coat was applied at an average rate of 34 sq. yds. per hour, at a labor cost of less than 7c per sq. yd. For this operation one man to operate machine, one to feed machine and one man to mix and carry mortar to the machine were used. The scaffolding used was especially constructed for this class of work, and is therefore moved from job to job with a small depreciation in value. The erection and moving of the scaffold work cost on an average of 10c per sq. yd. All wages paid to laborers are according to the specified scale of their respective union organizations.

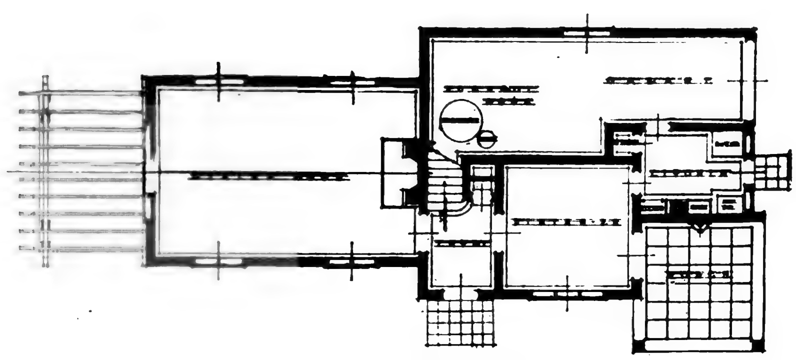
The placing of the stucco on the Stix home was done by the Cincinnati Stucco Placing Co., Cincinnati, O.

Fig. 2—Putting the Finish Dash Coat on the Side of the Porch

An English Cottage — *Back Plastered Stucco*

The English cottage type house shown in the illustration, from a photograph, and also in plan, was designed by Mr. Gore, architect, Paducah, Ky. Metal lath was used as a stucco base, on wood studs, and was back plastered. The design is presented through the courtesy of the General Fireproofing Co.





A Cold-Proof House in Saskatoon

By Randolph Patton
Saskatoon

Fig. 1—H. Gauvin's Cold Proof House — Built Like a Refrigerator

The severe climate of Western Canada has led to many attempts to solve the problem of keeping the cold out of the house, but none of them so successful as that of H. Gauvin, a refrigeration engineer of Saskatoon.

Mr. Gauvin has built a house which is so impervious to cold that he is able to use electric heating without prohibitive expense—a thing which has time and again been declared impossible by electrical engineers. These results have been obtained by using the most inexpensive type of insulated construction, and the first cost of the house was only 10% greater than that of ordinary frame construction.

In keeping down the expense of erection, Mr. Gauvin adopted pebble-dash stucco for the walls and tar and gravel for the roof. The price of lumber has more than doubled on account of the war, while the price of cement rose only 17%.

The house contains nine rooms, the total content being 20,000 cu. ft. There are 43 windows, but only two outside entrances—one front and one rear. A concrete basement extends under the entire house, and includes a concrete tank for soft water. The plans of the house are shown in Fig. 2.

Wall Construction

The outside walls are built on 8" studs. Centered on the outer edge of each stud is a 5/16" steel rod, to which metal lath is attached, thus keeping the metal lath away from actual contact with the edge of the stud. The outer coat of cement plaster and stucco was applied to the metal lath to a thickness of ¾". When this had hardened, back-plaster was applied between the studs. This back-plaster filled in between the edge of the stud and the metal lath, in the space provided by the 5/16" vertical rods. The outer section of the wall then consists of a reinforced concrete slab 1½" thick, attached to the studs.

When the back-plaster had hardened and dried, the entire back-plaster and faces of the studs were given a coat of hot pitch, each pair of studs and wall space between forming three sides of an air-tight vertical pocket.

The inner section of the wall was built up as follows: Two layers of asphalt paper tacked to the inner edges of the studs. On top of the paper, ordinary wooden lath and plaster finish.

Insulating Material

The air-tight spaces thus left between the studs were then filled with insulating material consisting of granulated cork mixed with 10% of dry planer shavings. This mixture was rammed and packed to the correct density (8½ lbs. to the cu. ft.). The idea was not to pack this material into a solid mass, but to give it sufficient density to prevent the circulation of air through the mass, and at the same time leave a fairly uniform distribution of minute air pockets.

Theory of Insulation

The theory of insulation on which this construction is based is to prevent the movement of warm air toward cold surfaces. If air pockets of appreciable size are left, the warm air will travel up the inner wall and either escape through a crack at the top or return downward along the inner surface of the outer wall, its heat radiating into the outer wall and thus being lost. Avoidance of convection currents, or keeping them within very minute limits, effectually prevents the transmission of heat through the mass.

Sill and Eaves

The greatest care was taken to prevent entrance of cold air at the lower floor line and to prevent the escape of warm air through cracks or other apertures under the eaves. In ordinary construction it is common to bring the floor sleepers out flush with the outside surface of the concrete foundation. Slight shrinkage of the wood leaves a crack on each side of the sleeper, through which cold air may enter. In this instance the sleepers were

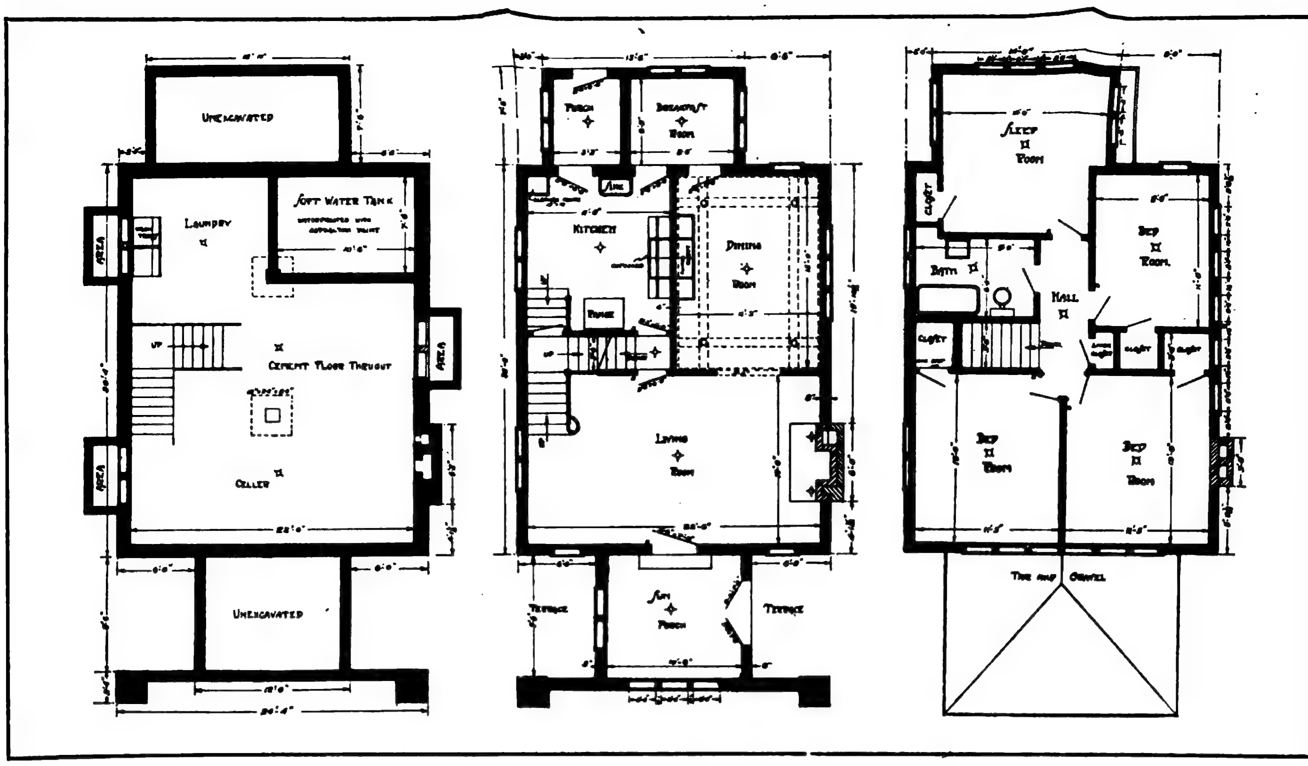


Fig. 2—Floor Plans of the Saskatoon Cold Proof House

not brought out to the surface, so that the outer face of the foundation is smooth concrete. An additional precaution was taken by painting the ends of the sleepers with hot pitch to prevent absorption of water from the concrete and consequent shrinkage. The stucco surface was carefully brought to an air-tight joint with the corner edge of the foundation.

The Roof

The roof is flat, pitching slightly toward a central rain pipe, which leads into a basement water tank. The roof rafters are 15" in depth. After the ceiling had been nailed up, the spaces between the rafters were filled with the cork and shavings insulating mixture to a depth of 15", the rough roofing was laid, and finished off with an ordinary tar and gravel composition. The roof framing, indicated in the accompanying cross section, was the simplest and most inexpensive that could be devised to meet the conditions. The roof overhangs the walls 4'; its outside thickness of 15" relieves the house of that look of strangeness which is sometimes obtained when a flat roof is used.

Doors and Windows

It is obvious that if the greatest economy in heating, during severe weather, is to be secured, no cold air must be permitted to enter the house, except that actually required for ventilation. To secure this economy, all doors and windows are weather-stripped with metal. There are only two entrances, one front and one in the rear. Both are double entrances, that is, a small entry-way or vestibule is provided, and one door is closed before the other is opened, thus preventing a rush of cold air into the house.

The importance of making the windows as nearly air-tight as possible is shown by the following air chamber test made by a New York testing firm for the builder of this house. The table shows the number of cubic feet of air per minute per linear foot of perimeter:

Wind Velocity m. p. h.	With Strip	Without Strip
15	.08	.75
33	.15	1.42
45	.29	2.88
65	.54	5.65
75	.80	8.45

The figures for windows without strip would of course be considerably greater as the window shrank and sagged with age.

But the battle is not over when the sash is made snug. The window casings were made of 2" material and were rabbeted at the joints. Each piece was primed separately to avoid shrinkage. The open spaces between the walls and frames were packed with mineral wool, and every crack was made air tight. When storm windows were fitted they were pushed snugly against felt strips. The result is that although there are 43 windows in the house, it is as snug as an underground cave, and the wind does not "drive the heat out" of the northeast bedroom.

Floors

The first floor is filled with insulating material between the basement ceiling and the rough flooring, and the second floor is also insulated for 4' around the outer wall.

Exterior Decoration

The decoration of stucco has been more or less of a problem; where batten strips are used for detail they have a tendency to shrink and become loose. This was avoided in this case by making a raised paneling of concrete. The first coat (usual standard mix) was applied to the metal lath. When this had hardened, back-plaster was applied, closing the key. When the back-plaster hardened, the wall had sufficient stiffness so that the detail work could be proceeded with. The second outside coat of stucco was then applied, and the raised borders brought up with a trowel and straight-edge. After this second coat had been applied, the pebble-dash was thrown on the panels, leaving the raised borders standing out as shown in the illustration.

The raised borders around the edge of the roof are of wood.

Heat Transmission

Tests in heat transmission through walls show that ordinary "double frame" wall, consisting of 8" studs, covered on the outside with double sheeting, and on the

FIG. 3—ELEVATIONS OF THE SASKATOON HOUSE OF NOVEL DESIGN

inside sheeted, papered, lathed and plastered, transmits 8.10 B. T. U. per sq. ft. per 24 hours for each degree of difference in temperature.

In comparison with this, the type of wall construction used in Mr. Gauvin's house transmits only 1.9 B. T. U.—less than one-fourth—under the same conditions.

The saving of fuel from this source alone is very considerable, but the construction was made much more effective by the elimination of convection currents, which in ordinary frame houses permit the heat to trickle through the roof.

HEATING PLANT

The heating plant consists of nine electric steam radiators. These are ordinary steam radiators with an electric heating coil inserted in the lower manifold. They are operated at 110 volts and 15 amperes. It has been found that it is not necessary to keep all the radiators going in order to keep the house comfortably warm, even in extremely cold weather. A table gives inside and outside temperatures, taken daily at 5 p. m.:

In maintaining this inside temperature the following amounts of electrical energy were used: October, 370

TABLE OF TEMPERATURES INSIDE AND OUTSIDE

Date	Outside Degrees	Inside Degrees	Date	Outside Degrees	Inside Degrees	Date	Outside Degrees	Inside Degrees
Oct.								
1	54	66	26	6	65	20	30	67
2	46	65	27	15	66	21	34	68
3	48	70	28	26	66	22	36	66
4	54	66	29	18	65	23	10	67
5	60	72	30	20	64	24	6 below	66
6	40	66	31	22	65	25	4 below	67
7	62	68	Nov.			26	6 below	67
8	28	64	1	18	64	27	0	68
		(Storm)	2	16	67	28	4	68
9	20	64	3	16	66	29	12 below	67
10	28	64	4	14	65	30	16 below	67
11	28	64	5	6	66	Dec.		
12	30	64	6	0	67	1	10 below	66
13	38	64	7	10	65	2	6 below	67
14	30	64	8	5	66	3	4	68
15	30	66	9	10	68	4	14	67
16	40	66	10	4	65	5	10	68
17	40	66	11	4	66	6	20 below	67
18	38	67	12	8 below	65	7	20 below	67
19	38	67	13	0	65	8	22 below	66
20	32	64	14	20	67	9	24 below	67
21	30	64	15	30	68	10	22 below	66
22	16	64	16	42	68	11	24	66
23	15	64	17	30	68	12	6	67
24	10	64	18	32	66			
25	6	64	19	38	68			

k. w. h.; November, 1145 k. w. h.; December 1 to 12, 857 k. w. h. At 2¼ cents per kilowatt hour, the bill for

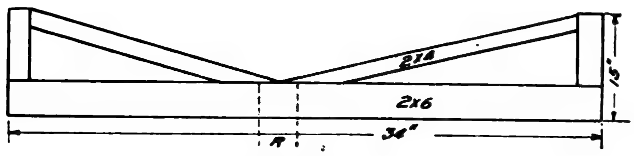


Fig. 4—Detail of Roof Frame

October was $8.32; for November, $25.76, and for the first twelve days of December, $19.18. These figures compare very favorably with the amount spent for coal in heating an ordinary house of equivalent size.

The radiators are turned off every night about 8:30. Even when the outside temperature reached 35 below zero, as it did December 9, the inside temperature next morning had fallen only to 54.

At night there is no one on the ground floor, and this is closed up tight. The bedrooms are ventilated by closing the door and opening a slide in the storm window, giving an open space 6" x 8". This ventilation is found quite adequate in cold weather, but the temperature of the bedrooms drops below the freezing point. The temperature on the ground floor remains steady, however. It is better ventilated than most houses in this country in winter.

The temperature of 66 to 68 is found most comfortable, as it is steady. The air is kept at a satisfactory humidity by leaving the top vent of the radiators open,

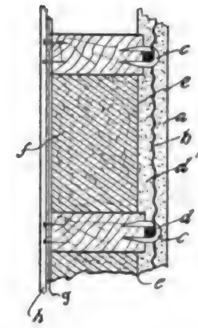


Fig. 5—Detail of Wall Horizontal Section

allowing a small amount of steam to escape into the room. No difficulty or discomfort of any kind has been felt on account of ventilation.

This type of construction is of course as well adapted to any other heating system as to this one, but it was thought that the convenience of electricity might be taken advantage of, since its cost was not likely to be unduly high. The electrical installation was made at a first cost of about 35% of what a steam installation would have cost.

Codes Extravagant With House-Building Materials[1]

By Fred W. Lumis
Building Commissioner
Springfield, Mass.

In studying the art of house building, we discover that the most successful houses do not depend upon ornament, nor any particular kind of material, for their success, but rather upon good lines, simplicity and reasonableness. Any building worthy to be called a house should be built of enduring material, and with proper care should serve three or more generations. Whether the material is wood, or brick, or stone, or concrete—the thought of permanence should always be engrossing, if not paramount.

Much time and thought have been given to the study and examination of building materials. They all have their virtues, their limitations and defects. However, we will only consider the house built with concrete.

Before a house or other building can be erected in any of our cities, an application for a permit to build must be made, a plan must be filed, also a written statement describing the character, materials, use, and location of such building; all showing the purpose of the builder to comply with the requirements of the state and local building laws.

It will be interesting, therefore, to examine briefly the building laws or codes of some of our larger cities, so as to learn, if possible, their various regulations and restrictions as they apply to and affect the concrete house.

[1]Presented at National Conference on Concrete House Construction, Chicago, Feb. 17-19, 1920.

Building Laws

I have tried to condense a dozen typical, existing codes, retaining only the salient features, reducing them to their simplest terms, and recording their actual mandatory requirements. These are as follows:

Boston

The tensional stresses in the steel are fixed at 16,000 lbs. per sq. in. The standard mixture for reinforced concrete is 1 of cement, 2 of sand, and 4 of broken stone.

Extreme fiber stress in slabs and other units, 500 lbs. per sq. in. In special cases, as in columns with vertical and hooped reinforcement, 600 lbs. per sq. in. in compression is permitted.

Plain concrete in mass, in compression, 350 lbs. Wall thicknesses for houses: Basement, 12", first and second stories, 8". The use of cinder concrete is permitted in floor slabs, roofs or filling.

Bridgeport

Allowable steel stresses, high carbon steel 16,000 lbs, mild steel 14,000 lbs. Extreme fiber stress in concrete, 600 lbs. In direct compression, 450 lbs.

Mixture—To withstand a pressure of 2,000 lbs. per sq. in. 28 days after mixing.

Wall thicknesses—Not less than 12", or the same as brick, except slight differences in favor of concrete.

Slag, and clean furnace clinkers are permitted.

Buffalo

Allowable steel stress, 16,000 lbs. per sq. in. Extreme fiber stress in concrete, 500 lbs. per sq. in. Direct compression, 350 lbs. per sq. in.

Mixture—1:2:5 cement, sand and stone, or gravel. Wall thicknesses the same as for brick.

Reinforced concrete walls for dwellings may be for one story: Basement, 8″; first story, 6″. For two stories: Basement, 10″; first story, 6″; second story, 6″. For three stories: Basement, 12″; first story, 8″; second story, 6″, and third story, 6″.

Chicago

Allowable stresses: Mild steel in tension—18,000 lbs. per sq. in.; extreme fiber stress in concrete, 35% of the ultimate crushing strength; direct compression, 20% of the ultimate crushing strength.

Various mixtures of cement, sand and broken stone are prescribed as follows:

(Best) 1:1:2; 1:1½:3; 1:2:4; 1:2½:5; 1:3:7.

The crushing values of these respective mixtures are given as 2,900, 2,400, 2,000, 1,750, and 1,500 lbs. per sq. in.

Wall thicknesses are the same as for brick. Cinders: Clean, screened free from ashes or other matter, are permitted, except in bearing walls, columns or piers.

Cincinnati

Allowable stresses:
Steel in tension, 16,000 lbs. per sq. in.
Concrete in the following table:

Mixture:		Extreme Fiber	Direct Compression
Sand and crushed stone....	1:2½:5	600 lbs.	500 lbs.
	1:2 :4	700 lbs.	600 lbs.
	1:1½:3	800 lbs.	700 lbs.

Allowed load for plain, mass concrete, 200 lbs.
Walls are permitted of reinforced concrete not less than 4″ thick.
Reinforced concrete basement walls, 12″ thick.
Walls for first and second stories, 8″ thick.
Cinder concrete may be used in floor arches or slabs only.

Detroit

The allowable stresses are:
Steel in tension, high carbon, 18,000 lbs. per sq. in.; mild steel, 16,000 lbs. per sq. in.; extreme fiber stress in concrete, 650 lbs. per sq. in.; in direct compression, 450 lbs. per sq. in.
Mixture, for walls, beams and floors, 1:2:4.
Mixture for columns, 1:1½:3.
Wall thicknesses for reinforced concrete, 66% of that required for corresponding brick walls.
Walls of plain concrete to be of the same thickness as required for brick walls.
Slag is permitted in walls and slabs.
Boiler cinders prohibited.

Hartford

Steel stresses, high carbon steel (ultimate), 18,000 lbs. per sq. in.; mild steel (ultimate), 16,000 lbs. per sq. in.
Extreme fiber stress in concrete, 800 lbs. per sq. in.
Direct compression—In walls, 500 lbs.; in hooped columns, 850 lbs. per sq. in.
Mixtures, 1:2:4 sand and crushed trap rock, 1:2:4 cinder concrete, is allowed at 50% of the above values.
Concrete blocks, mixture, 1:3:4, to stand a test of 1,000 lbs. per sq. in. at the end of 28 days. Allowable working load, 90 lbs. per sq. in.
Wall thicknesses for houses: Basement, 12″; first story, 8″; second story, 8″.
The approval of concrete block material is given only under the following conditions: A plant must be in full operation when the official tests are made. The names of the owners of the plant must be placed on file with the Building Department.
To make blocks, a license must be obtained. The license may be revoked for the following causes: Willful violation of requirements, dishonest methods, or the use of improper materials.

Los Angeles

Allowable steel stress—16,000 lbs. per sq. in.
Allowable stresses in concrete as in table:

Mixture—		Extreme Fiber Stress	Hooped Col.
1:2½:3½	Crushed rock	650 lbs.	800 lbs.
1:3 :4½	Screened gravel	520 lbs.	Dir. Com. 350 lbs.
1:7	Bank or river gravel............ without reinforcement		Mass Concrete Dir. Com. 250 lbs.

Walls—Plain concrete, same thickness as required for brick walls.

Block concrete, same thickness as brick walls.

Reinforced concrete, filler or curtain walls not less than 8″ thick.

Los Angeles has the following provision for inspection:

The inspector must qualify. He must see that all work and materials comply with the requirements of the ordinance—or stop the work—upon penalty of a fine of not more than $500, or imprisonment for not more than six months, or both.

Louisville

Steel stress, 16,000 lbs. per sq. in.

Mixture, 1:2:4, broken stone or gravel, to be what is known as 2,000 lbs. concrete.

Extreme fiber stress in concrete, 650 lbs.

Direct compression—In mass concrete, 650 lbs. (unusually high); in columns with vertical reinforcement only, 450 lbs.; in columns with hoops only, 540 lbs.; in columns with 1% to 4% vertical reinforcement and hoops, 650 lbs.

Cinder concrete prohibited for construction work or fireproofing.

Walls—12″ thick for first and second stories. If only one story high above basement, the first story walls may be 9″ thick.

Walls of hollow concrete block may be built 10% less in thickness than brick or monolithic walls.

Minneapolis

A rigid preliminary requirement compels the designer of any reinforced concrete building or structure to carefully compute the dead and live loads and the resulting stresses, and indicate all of them on the drawings.

Steel value, 16,000 lbs. per sq. in.

Mixture—1:2:4, must stand a compressive test of 2,000 lbs. per sq. in.

Extreme fiber stress, 650 lbs. per sq. in.

1.2.4, mass concrete, 500 lbs. per sq. in.

1:3:5, mass concrete, 208 lbs. per sq. in.

Walls for dwellings: Basement, 12″; first and second stories, 10″ each. Mixture, 1:3:5 stone or gravel. Cinder concrete not considered.

New York

Allowable steel stress, high carbon steel, or cold drawn wire or fabric, 20,000 lbs.; mild steel, 16,000 lbs. per sq. in.
Mixture, for reinforced concrete—1:2:4 or better, with a crushing resistance of not less than 2,000 lbs. per sq. in. at the age of 28 days.
The aggregate to be screened, crushed stone, or gravel.
Extreme fiber stress in concrete, 650 lbs.
Direct compression, 500 lbs. per sq. in. on the concrete, plus 9,000 lbs. per sq. in. on the vertical steel reinforcement.
Mixture for mass or plain concrete, 1:2½:5.
Aggregate to be granite, trap rock, or gravel—thoroughly cleaned.
Walls: Foundation walls for residences not less than 12″ of reinforced concrete, 8″ walls, 20′ high, are allowed above the basement; 30′ walls are permitted, if the first 10′ in height is 10″ thick.
Cinder concrete is permitted in floor slabs, in reinforced partitions 4″ thick, and in plain partitions 5″ thick.

Philadelphia

Value of steel, 16,000 lbs. per sq. in.
Extreme fiber stress in concrete, 650 lbs.
Direct compression, 500 lbs.; allowed compression on plain concrete in walls or large piers, 250 lbs. per sq. in.
Mixture—1:2:4, to develop a crushing strength of 2,000 lbs. per sq. in. in 28 days.
Aggregate—Stone, gravel, or slag.
Cinder concrete permitted for slabs and minor partitions, mixture 1:2:5, and should develop a crushing strength of 800 lbs. in 28 days.
For cinder concrete the allowed extreme fiber stress is 300 lbs.
Reinforced concrete will be approved for all types of building construction, provided the design conforms to the requirements of good engineering practice, and the working stresses do not exceed those establishd in the code.
Walls of reinforced concrete may be 66% of the required thickness for brick walls; the concrete to be reinforced with approximately 1/5 of 1% of the cross section.
Concrete blocks 1:2:3 mixture of sand and gravel may be used in house construction, in walls of the same thickness as brick walls.
A system of rigid tests is established.

St. Louis

Allowed stresses in steel, high elastic limit steel, 20,000 lbs. mild steel 14,000 lbs. per sq. in.

Extreme fiber stress in reinforced concrete, 800 lbs.

Direct compression, 500 lbs. per sq. in.

Mixture, 1:2:4, reinforced concrete to resist 2,000 lbs. test in 28 days.

The use of a 1:3:5 mixture for plain concrete is permitted.

Hard burned clay is sometimes used as an aggregate, the allowable working stresses being approximately 50% of the allowance for stone concrete.

Walls, same thickness as for brick. Basement, 13"; first story, 13"; second story, 13" thick.

No provision is made for concrete blocks.

Only high grade portland cements are considered in any of the building codes to which reference is made.

Discussion

In designing the concrete house, safety and economy must be reconciled.

If to embed the steel reinforcement 1½" or 2" is sufficient to protect it from fire in a store house, or other commercial building, where large quantities of inflammable materials are stored, then ½" of fire protection should be enough when the steel is embedded in the concrete walls and floors of a small house, where none of the rooms would contain more than a few armfuls of combustible furnishings.

Where crushed slag is procurable, it might well be substituted for crushed stone in concrete, for use in dwelling houses.

Cinders are variable in their structural and chemical properties, but their use in construction work, in small buildings, might be permissible in localities where other material is difficult to procure, or where they can be obtained in a relatively uniform and clean condition. They should be crushed and screened, and free from ashes.

Building codes should require every maker of concrete blocks to have a suitable building or enclosure for protection from cold, and heat, and winds, and weather, where he shall properly make and cure his blocks. Licenses should be issued to all block makers. Such licenses to be revocable for causes set forth in the code.

In considering the codes which I have mentioned, it will be observed that the requirements are general and not specific. Alike to the warehouse—a thousand feet long—and to the cottage—with partitions serving as diaphragms, extending in all directions, tying and bracing the whole structure, every few feet.

The vertical supports and walls in large structures are designed principally with respect to their compressive strength; but the designer of a concrete house is not permitted to utilize any such economies.

As an illustration: a good reinforced concrete house, having horizontal dimensions of 30' x 40', and an average height above the basement of 20', would weigh, including outside walls, floors, partitions and roof, approximately 150 tons—and if all the floors were loaded to their full carrying capacity of 40 lbs. per sq. ft., it would add about 50 tons more. The weight of the whole building, above the basement, together with its live load, could be safely supported upon one well designed concrete column 23" in diameter. In the vertical supporting members in a typical concrete house there is material sufficient to make 25 such columns.

Newer Codes Needed

Now this is extravagant designing—an unnecessary waste of valuable material. The designers are not encouraged to apply their inventive genius, or even the best of their training and experience, but in many cases are restrained and handicapped by the requirements of existing building codes—codes that are influenced by other codes, which in turn are influenced by older and different methods of building. There is no logical reason why concrete construction should be measured in multiples of 4, 8 or 12", just because brick and stone are figured that way.

To begin with, portland cement concrete is a comparatively new material, and new uses for it are being discovered every day. Until very recently the concrete house was designed on the same lines and with the same details as a brick or stone house. And it was but natural that existing or incongruous building regulations should be applied to it.

But we are progressing. The engineers have led the way, showing us how to build with concrete scientifically and safely. The factor of safety can be very greatly reduced when ignorance, dishonesty, and carelessness are noticeably reduced, and better controlled.

The men who are really responsible for our building codes have worked to get away from archaic methods, have had to oppose ignorance, perversity, and the entrenched interests. They have had to arouse and mould public opinion, and receive its sanction, before they could establish and maintain necessary reforms, or enact building codes.

With a slight improvement in the intelligence and reliability of the average man, and a better and more universal understanding of the proper treatment and behavior of concrete—in all places and under all conditions — great economies both in the material and manipulation can be effected, and satisfactory results obtained.

Our building codes are primarily written and enforced for the dual purpose of protecting human life and the prevention of fire. They must occasionally be revised, so as to comprehend new materials, and new methods.

The concrete house of various types of construction will gradually and shortly come to be considered on its own intrinsic merits, and building codes will contain provisions that will be specially applicable to such houses.

The concrete house, with its unlimited opportunities for style, finish and decoration, has a value and a charm all its own. The designer should bear in mind that he is expressing himself in terms of concrete, and also that it is a medium worthy of his best thought and his noblest effort.

Living in Concrete Houses

A Symposium From First Hand Knowledge[1]

Walter E. Andrews Florence Holland Clayton B. Potter
Wilson D. Lyon Homer Laughlin, Jr. F. L. Williamson
L. N. Babbit

The House of a Thousand Years

By Mr. Andrews
Seattle

Ten years ago I had the building bee in my bonnet so bad that I was going around in circles from one architect's office to another. But I wanted more than a mere house for the moment—I wanted something as permanent and durable as time itself, something that would last for a thousand years and still be cold proof, heat proof, wind proof, earthquake proof, rat proof, and all the other proofs.

Wood construction was out of the question; I didn't like brick or stone; hollow tile was then little known, and steel would rust. Finally I found an architect who believed in reinforced concrete with all his soul. He talked it, dreamed of it, wrote about it, and welcomed me like a long-lost brother. His name was Oliver Randolph Parry.

Well, I took a long breath—and let him go ahead. And the result (at Wayne, Pa.) is shown by the accompanying illustrations.

I lived in that blessed house eight happy years, and would have been there yet if business and family reasons had not called me away. The present owner, J. Fewsmith, likes it as well, I believe, as we did, and in the community the building is known as "the white house."

Fig. 1—Entrance to the "House of a Thousand Years"

When the wind blows it never shakes nor even trembles. In summertime it is very cool, and in winter very warm. No rat or mouse ever gained entrance through its walls. It has never been damp in the slightest degree, nor has it cracked, chipped, crumbled, or done any of the sad things that were predicted for it by various solicitous friends and neighbors. Once in two years I gave the outside walls a coat of ordinary government whitewash—the kind used on light-houses. A painter applied it with a big brush, quickly, and the bill each time, I remember, was only about $25. White? It was the whitest white you ever saw! With the green shingles and the green vines for contrast, it made a picture worth looking at.

This is not the place for a technical description of the construction details, so I shall give only a few brief general statements. The pictures plainly show the method of construction, and how the forms were raised from time to time as the work went on. The concrete was poured by hand in a slow, primitive way that would

[1]Contributions by Mrs. Holland, Messrs. Andrews, Potter and Lyon are from Concrete, Jan., 1920.

FIGS. 2 AND 3—THE PORCH AND PERGOLA OF THE "HOUSE OF A THOUSAND YEARS"

THE GREEN OF THE FOLIAGE SETS OFF THE CHALKY WHITENESS OF THE HOUSE AND THE PILLARS

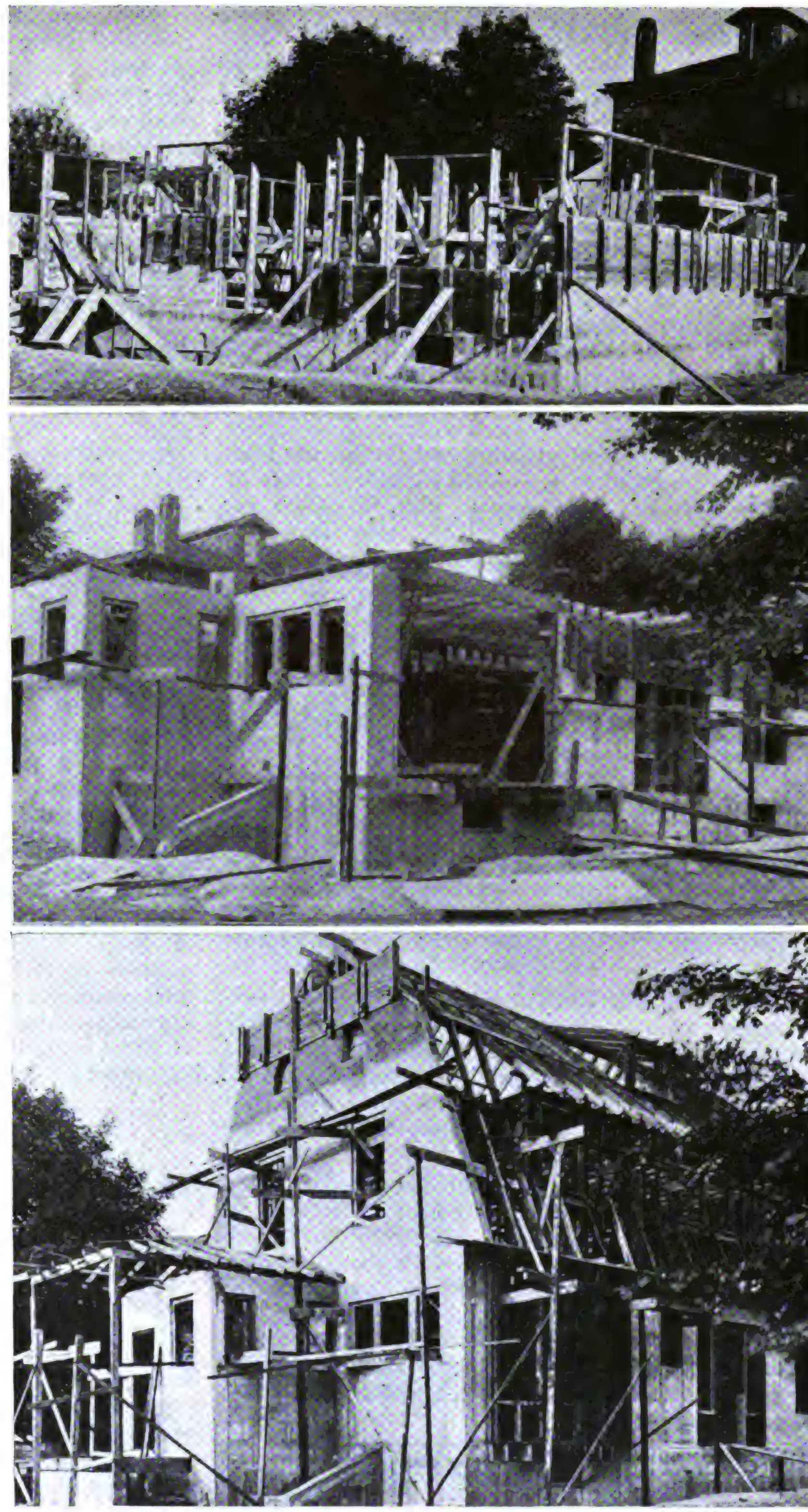
be much improved upon nowadays; and, when the forms were raised in a day or so, the not-yet-hard wall was dampened and rubbed down with a wooden float, giving it a rough sand-finish and obliterating all board marks. When the walls were done the house was a solid monolithic mass from the cellar to the roof, tied together with vertical steel rods and horizontal wires embedded in the concrete.

The last thing was a waterproofing compound brushed into the outer surface when the walls were finished. They were then ready for the whitewash a little later. On the inside of the walls furring strips were placed, and the lathing was fastened to these, thus leaving a half-inch air space between wall and plaster—which greatly added to the dryness and warmth of the house. The walls are 12″ thick from basement to first floor, 8″ thick from first floor to second floor, and 6″ thick from there to the peak of the roof.

Do you see those nice, big, fat pillars on the porch? They were cast in molds right where they are, and weigh about two tons each. If you happen to look at them a thousand years from now they'll still be there unless somebody blows them up with dynamite in the meantime. The same molds were used to make the pergola pillars in the garden. The pool is of concrete, too, and so are the porches and steps thereof, and the chimneys. I wish now that I had made the floors concrete, and then covered them with oak flooring. But at the time it did not seem advisable.

It is a twelve-room house, with some extra room on the third floor if wanted. To duplicate the place today, including the garden and not the lot, would cost—well, frankly, I'd better play safe and leave that to some of your builder friends. Ten years ago it cost me $7,000 without the ground, at which price I am inclined to think that the contractor failed to make any money.

The upkeep of this house has been surprisingly little and will continue to be little in the years to come. Aside from room, window-frames, etc., there is nothing to wear out or decay.



Figs. 4-6—Progress Views of the Construction of the Andrews Home

If I were going to do it again, I should specify *white* cement in place of the ordinary kind, and thus save the necessity of whitewashing the exterior every two years. But that's a small matter compared to the joy and satisfaction of building and living in a thousand-year house. My wife says that she never expects to feel so safe and comfortable in any other house in all this world!

The Gray House on the Rocks

By Mrs. Holland
Marsh House, Darien, Conn.

I have been asked to write to you about our concrete house, built for us in the autumn and winter of 1916, by W. G. Wood, of South Norwalk, Conn., from designs by Huntington Bosworth, of New York City. We have lived in the house continuously since June, 1917, both winter and summer, and have found it absolutely satisfactory in every way. It is built on a high, rocky island in Long Island Sound, surrounded on two sides by water and on two sides by salt marshes and though the location is very beautiful, it is exposed to the full force of every storm from every direction, with no shelter but the oaks that cover the island. In the three years since it was built we have not needed a single repair. There are no cracks and no leaks.

The house is warm and dry in winter, and cool and dry in summer—except when the heavy fogs blow in at the open windows. It is very easy to heat. We have only a hot air furnace and many casement windows and tiled floors, but have no difficulty in keeping comfortable in the coldest weather.

The style of our house was inspired by the houses that cling to the rocks on the coast of Sicily, between Catarnia and Taromina. The shape is particularly fitted to the rocks on which the house is built. I do not think it could have been built of anything but poured concrete. All the angles of the house outside were rounded by drawing the hand over them, which gives an appearance of age.

On the marsh side is a paved court yard with a narrow covered cloister on two sides, which was the only way to make a sheltered entrance from a motor car to the front door. There is a garage and large studio all under the same roof, but in spite of these modern features, the effect of the whole building is at least 300 years old.

The walls of the house are solid concrete, 12″ thick, plastered on the inside and stuccoed on the outside, all in the natural light, warm gray of the cement. I think it very important that the concrete walls should be stuccoed on the outside with one coat of natural colored stucco, that is, colored only by the cement and put on by any Italian laborer with a trowel, with no effort either to smooth or roughen it. Any Italian peasant can do it, as he does it at home, making a beautiful, soft surface.

The roof is of terra cotta tile[1], a dull moss green in color, and roughened to look mossy and weather-beaten. There is *no wood work* on the outside of the house. The window frames are deep in the walls and only 1″ wide, and stained with creosote. The windows are all rather small casement windows, opening out (and they do not leak), with very small panes.

Inside there is no woodwork except door and window frames 1″ wide, sunk into the walls. The second story floors and stairs are wood, also the doors, which are all heavy buttress, with wrought iron latches and long hinges.

I do not think it necessary to lath and plaster inside. Our architect and builder insisted on doing it, but the garage, which is only concrete, has never had any moisture on the inside walls, and is dry as the rest of the house—also the cellar.

We are convinced that concrete is from every point of view the nicest possible material for building. It is practically everlasting, and beautiful if treated properly; fireproof, and comfortable to live in, and I believe much cheaper now than wood. Everyone who has seen our house says it is the most interesting and picturesque for a small house that they have ever seen in this country.

Favors a Concrete House with a Double Wall

By Mr. Potter
Pine Ridge Place, Delaware, N. Y.

We built our concrete house and we have lived in it about three years, and we all believe more firmly than ever in the slogan of building for permanence. If I can say a word to induce others to practice on the same line, I shall be glad to do so, and the details in this attempt to write are gone into especially to show to the inexperienced that they, too, may do what we have done, for it was our first attempt to build our own house.

The idea of safety and permanence were always most prominent in my notions of a house, and to get these always seemed too expensive for me to attempt. Brick or stone would require experienced, high priced labor and material, and neither brick nor stone would be as warm as wood properly sheathed, unless some provision were made for an air space in the walls, and that again would add to the cost—make it prohibitive, except to one of wealth. And wood will easily take fire and burn quickly—or, if fortunate enough to escape the ravage of fire, soon begin to decay, always require frequent painting and painting is very expensive now, with good paints at $3.50 to $4.00 per gallon, and unskilled painters being offered $7.00 per day.

Our house is built of double concrete walls. Each wall is 4″ thick, with a 2½″ air space between, extending from the foot wall to the gables—and then sealed with a 2″ plank bolted and cemented in; built with common labor, three Italians and myself, in October and November, 1915.

There is not a crack or break to be found in any part of the wall today, and the concrete was the cheapest in cost of any part of the house, and at the time of building actually cost less than either stone, brick, concrete block or wood.

My son sketched the plans for the house, gave them to the architect to finish to scale, and supply the blue prints and specifications, all of which was for a wood frame construction to cost about $4,500. He did not approve of concrete, nor believe it could be built of concrete for less than $2,000 additional. No one in this vicinity, other than myself, would believe it possible to construct of concrete a double wall with a machine, admitting of instant release after being filled and tamped. I had seen several houses that had been built with the Van Guilder hollow wall machine, though I had not seen an inch of the work being done. I had seen the machine and how it was to be used, and believed in it.

A contractor in Albany put in a bid of $6,200 for wood construction.

We built of concrete, and, not counting my own labor, our money outlay was less than $4,000; the walls cost less than $1,000.

I am not a carpenter or builder; neither am I a mason—only just handy enough with tools to do some things for myself—and am telling all this simply to show that anyone can build any kind of structure in house, barn, garage, chicken house or other buildings, with unskilled help, with such a machine, and of the most abundant and cheapest materials.

We did let the contract for the wood work to a first-class builder. Also for one brick chimney, the top of the concrete chimney, which was built up with the walls, and the inside plastering and the fireplace. All the interior plastering on outside walls was done directly on the concrete as left by the machine. There is not a flaw or crack in it. The partitions were lathed on studding, and these wooden structures are the only places where any cracks are found.

We do find it satisfactory to live in; we are warm in winter and the hottest days that come in summer we find it the most delightfully cool house we have ever lived in; and everyone who comes in at such times remarks it. We feel very safe from outside fires. Of course, the inside woodwork would burn if it were fired.

When the outside is plastered or stuccoed, it does not have to be renewed, as do painted walls. The only outside painting we have is the window and door trim and under the eaves and the gables.

As to disadvantages as compared with other construction, I think it hard to find any. Should one desire to make changes that required cutting out any portion of the walls, one would find it much more strenuous than either wood, stone or brick.

It is better in that it is safer from wind, fire, or flood than either wood, stone or brick. It will stand where the other materials would crumble or disappear. The next glacial period may grind it up, but that is 25,000 years ahead yet, and I'll not be here. If I were to build again for myself—again—again—again and again, I would build with *double wall concrete.*

Concrete House is Cheap, Fireproof and Durable

By Mr. Lyon
Glen Ridge, N. J.

I find my Van Guilder hollow wall house very satisfactory;[1] I am exceedingly pleased with it, in fact. I don't think there is a crack in the shell anywhere; the house retains heat nicely in winter, and keeps cool in summer. I would suggest that any one using it should start the hollow wall at the footings, which should be well below frost. The air space works well this way, but isn't good if started at the ground line. The reason for this is that the cold carries through and the wall near the floor being colder than the air, condenses the moisture in the air and spoils the decorations. There is nothing of this kind where the air space goes down to the cellar floor. The top of the wall should be protected, so that the cold doesn't carry through to the inner wall at this extreme; the window casings and door casings should be tongued into the air space.

A great advantage of this system of construction is in the ability to plaster on the inner wall, thereby leaving no place for ice or rats or vermin of any kind to get in. After two years there seems to be no settling of the shell. I used wood beams inside and my walls have cracked less than a frame house. If there are not too many corners to turn and washed cinders can be procured, I believe it is as cheap or cheaper than any equally durable construction. With a tile roof, such as I have, I do not fear fire from the outside, and if the first floor is fireproofed there is almost no chance for fire within. Did a fire start, it wouldn't get far, if there were any sort of fire protection within call.

The only disadvantage I know of would be if I wanted to change the building now; it is rather more permanent than bricks or hollow tile, but there is a satisfaction in living in a solid, well built house, dry as a bone to the cellar floor.

[1]See description, Concrete, January, 1919.

A Superior Type of Construction[1]

By Mr. Babbitt

I am glad to make a statement as to the living conditions as we have found them in our concrete houses during the last three years. These houses, it will be remembered, were built by Mr. Hazen, Mr. Fuller and myself, in 1910, and were described in the May, 1911, issue of *Cement Age*. Briefly, the houses are of solid reinforced concrete, with reinforced concrete floors and stairs. The roofs are of tile on wooden rafters and decking. The outside walls are 8″ and 6″ thick, and are furred on the inside. A 1″ air space is left between the wall and the plaster on metal lath. The bearing walls and the ceilings were finished by rubbing smooth with carborundum brick and left in this condition. The partition walls are plaster on metal lath. The floor surfaces in the three houses are oak for the second floor sleeping rooms, tile and concrete for the living rooms. The cost of these houses was $7.50 per sq. ft. of gross area. This included one-third of the porch area.

After our experience of four winters, I can say that we much prefer this type of construction to the frame dwelling. The past winter has been unusually severe, with zero temperatures accompanied by very high winds. In spite of our exposed position the wind and weather have in no way affected the interior comfort of our houses. One thing stands out forcefully, and that is the solidity and tightness of the concrete house in a high wind.

In my own house, of about 1,200 sq. ft., I have burned about 12 tons of coal each winter, and every one of our 10 rooms has been comfortable. From our own experience the heating proposition presents an interesting point. The temperature of our main floor rooms has sledom been above 70° F. and with very few exceptions has not been below 60° F. In other words, during the entire winter the hot water system has been so operated as to keep the rooms within a range of 10°. This, of course, does not apply to the sleeping rooms. This regular temperature is possible because the concrete partition walls and floors seem to absorb any excess heat, and if the fire gets low at night the radiation from the concrete keeps up the room temperature. Another point is that with solid floors there are no drafts and the difference in room temperature between the floor and ceiling is very little. I have no figures on this, but it is nothing like the rooms in some frame houses, where t' difference is sometimes more than 10°. Perhaps the reason for this even temperature is the heat in the concrete floors, and perhaps also very slight convection

[1]From Concrete, April, 1914.

currents produced by the outside walls, which, while furred, must have some effect upon the room temperature.

In summer time the houses are very comfortable, and I think have an advantage over the frame house in evenness of room temperature. That is, the interior does not fluctuate with the mid-day heat.

We have not experienced dampness at any time.

Our concrete floors we have found comfortable and easy to take care of. After our experience with oak, concrete and tile, our choice would be the latter. A good quality of tile, well laid, is decorative, comfortable, and can be kept immaculate. Where children are in evidence, and several times a day bring in snow, mud and water in the main hall, the tile is much to be preferred, as all that is needed is a mop to restore it to its original condition.

The exterior of the houses seem to improve with the weathering, and both exteriors and interiors have proven satisfactory. Not a dollar has been spent for repairs, and no insurance is carried. To our way of thinking, the concrete house is a superior type of construction.

Delighted With Livability[1]

By Mr. Williamson

We are now in the midst of our second winter, and are delighted with the livability of our house.

The construction is of the monolithic hollow wall type, with concrete floors, concrete stairs, and even concrete cornices with integral gutter. Under our conditions here no other form of construction that would be desirable, or that should be considered for good residence construction, is as cheap. I believe, however, that there will always be a tendency on the part of one building a concrete home to spend more money on it, as they realize when building a permanent structure that everything they put into it should be of the best.

Our floors are oak, with the exception of two enclosed porches, that have the ornamental concrete tile, and the kitchen and servants' dining rooms that have plain concrete floors. I am very favorably disposed to the more general use of concrete floors, as we have found them very satisfactory. We gave the kitchen floor a coat of high grade floor varnish, thinking that it would be more easily kept clean. We have had no trouble whatever from dampness, and do not consider there is any possibility of trouble on that score. The house is noticeably cool in summer, as no heat is tranmitted through the walls, and the same condition is also helpful in the winter season, as the building more completely holds the heat.

One noticeable advantage of the concrete construction is the fact that the building is so sound-proof and so substantial that there is no annoyance from noises or from vibrations that often come in houses using wood joists and studdings. There is also the feeling of security that comes from the knowledge that the building is fireproof.

The use of portland cement for plastering has proven most successful in connection with metal lath and metal studding for the partitions that were not needed as supports for the floors. We have secured permanent construction and avoided the cracks that are so common in walls as ordinarily constructed.

[1]Concrete, January, 1917.

Satisfactory Concrete Floors, and How Finished[1]

By Mr. Laughlin, Jr.

To give you accurately my experience in living in a house with concrete floors, it will perhaps be well to go back a little way and relate my experiences which led to the adoption of a concrete floor for a residence.

The Homer Laughlin Building, which I own, was built in 1898 and was the fifth building in the United States, and the first building west of Chicago, to use concrete floors. These were concrete floors placed on a steel skeleton. At the time the building was opened I had grave doubts of its success, because every prospective tenant brought up the subject of the floors. Either they themselves were affected by rheumatism or they had some one in their office who had rheumatism, and they were quite sure that living in an office with concrete floors would be detrimental to their health. The common remark was that they could feel the chill of the concrete go through them the moment their shoes touched the floor. Although the prejudice was gradually overcome, it was at least five years, when concrete floors in office buildings had become more general, before the attention of the public was attracted to other features and away from the concrete floors, and I may safely say that it has been at least three years since I have heard a single person mention the subject.

When I was about to erect my home and decide on the subject of floors, my father, who had been a strong advocate of concrete floors in office buildings, advised me against their use in a residence. Careful inquiry developed that he himself was not opposed to the floors, but was satisfied that my friends and others would interpose all the objections to their use in a residence that we had formerly gone through in our office building, and so I decided to put wooden floors downstairs for the benefit of my friends, and concrete floors upstairs for the use of my family; but finally we worked up one excuse after another for leaving the wood floors out of certain downstairs rooms, and finally they were left out altogether.

My floors are of a warm brown tone and come up on the side walls about 6″ and flush with the plaster, to form what would otherwise be a baseboard. Downstairs they are decorated with a pallette-knife and look somewhat like carved leather. After the "carving" had been done, an artist worked various colors of the rainbow into the decoration, and then they were all varnished and waxed so that keeping them in order is similar to the polishing of wood floors, but the polishing is required much less frequently.

Upstairs we use velvet carpets of double width and plain colors, sewed together to form a mat or rug, but without a border, and extending within 6″ or 8″ of the side walls all the way around. We find that no nailing strips or other means of fastening are necessary, since the carpet lies perfectly flat and is sufficiently large so that it will not move about.

Downstairs we use Oriental rugs entirely, and a curious feature in this respect is that moths will not hatch on the under side of a rug in contact with concrete; where they do hatch when it is in contact with wood. This applies to the under side of the rug only, because

[1]From Concrete, January, 1915.

it is not impossible for them to hatch within the rug fabric itself.

Now, the common impression is that a concrete floor will make the room cold, but this impression is reached by people who have gone into rooms with concrete floors where there was no carpet on the floor and because at the moment they were critical of concrete, but if one will go into a bare room where hard wood floors have been used they will get exactly the same effect. The addition of carpets and tapestries decreases the number of square feet where the air of the room comes in contact directly with the floor or side walls.

There is also an impression that concrete floors are damp. They are damp for the first two months after being laid, and on this account should not be varnished or waxed, but after this period they are as dry as wooden floors. I have made accurate tests with hygrometers, to determine this point.

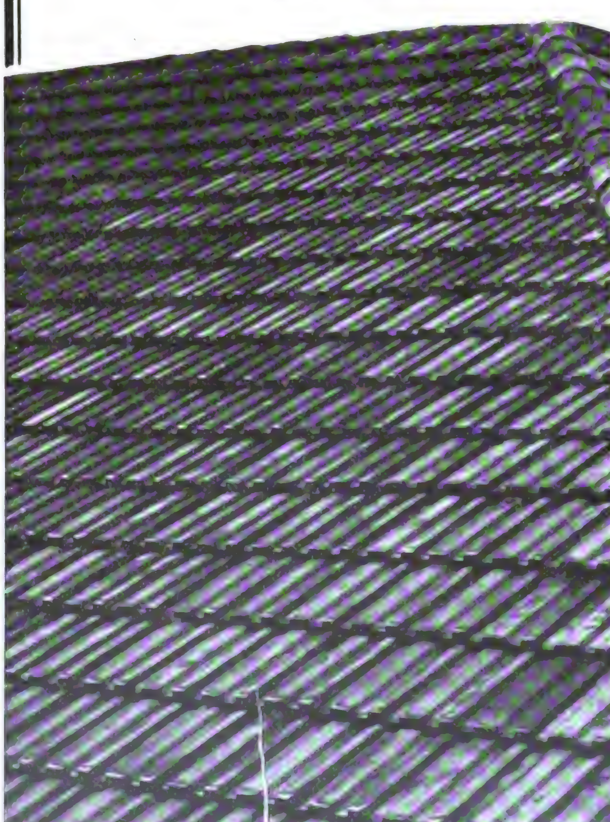
The concrete floor is to me most satisfactory because it is free from cracks in which dust accumulates and ascends every time the floor is flexed by stepping on it. There is never a squeak or other noise produced by the rubbing of one board of the interior floor on another. With carpet on the floors they are absolutely noiseless, and one cannot detect a person walking on an upper floor when he is in the room below, provided, of course, that there is a carpet on the floor above.

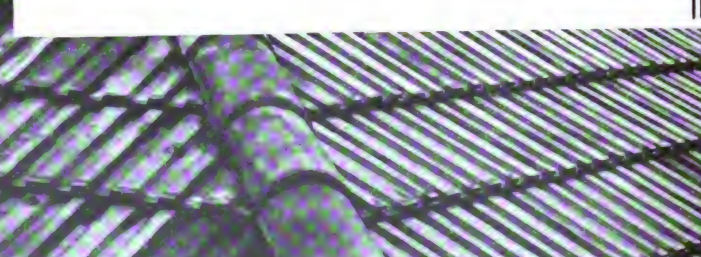
The concrete floor makes a much handsomer setting and background for Oriental rugs than wooden floors, and one can do away with the unsightly baseboard, which always collects dust. Then there is none of the trouble of warping and straining which comes with the use of wooden floors.

Above all else, the house is fireproof when properly built in other respects, and one can leave home with the assurance that neither property of any considerable value nor lives will be destroyed in the event of fire. I feel that my pictures, rugs and porcelains are as safe in my house as in a vault at the bank, barring the possibility of theft, which is rather remote.

Advertising Section

Here follow the announcements of nineteen manufacturers whose activities in promoting concrete house construction have been recognized and whose messages will, we feel sure, be of interest to the readers of this book.

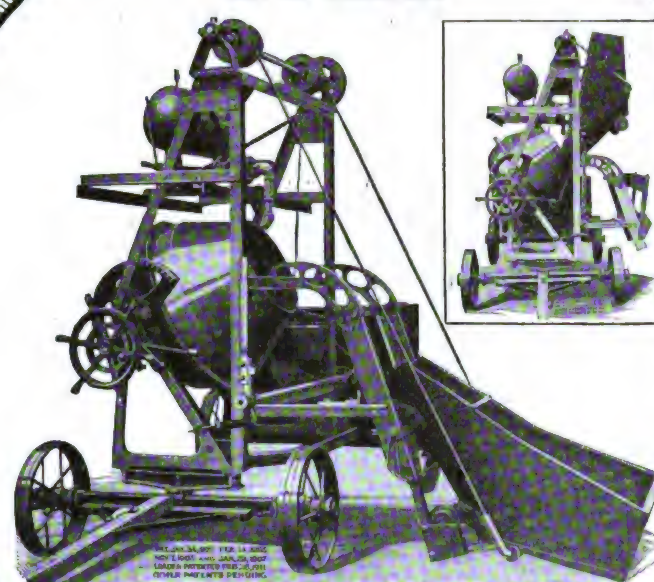




Wonder Mixers

No better evidence of WONDER Superiority could be desired than is afforded by the fact that many of the largest engineering and contracting firms in the country are **standardizing** on the WONDER.

They take the Backache out of Concrete



Built in Capacities of 4, 5, and 7 cu. ft. of Mixed Concrete per Batch

If you want small mixer investment—great adaptability—a mixer that you can run into a basement or lift to an upper story—take the WONDER *without* Loader — three sizes to select from—all can be equipped with Auxiliary Hoist at small extra cost.

If you want larger capacity and larger profits, take the WONDER *with* Folding Track Loader. Loader practically doubles capacity and equips you for all kinds of work. You get high speed, yet longer mixing time per batch than other mixers at same discharge interval — also ground level charging—the only real low charging. This is the greatest achievement in mixer building.

Send For The Wonder Catalog

Before you build your next concrete house, send for our Catalog. This gives full specifications of the mixers that have put thousands of contractors "on their feet" and swelled the profits of thousands more. It shows why "WONDER" Mixers are superior in principle and construction—how they mix mortar as well as concrete—why they pay largest dividends on investment. Ask for your free copy of this catalog today—a post card will do—just say—"Send me my copy of the Wonder Catalog."

Waterloo Construction Machinery Co.

105 Vinton St., Waterloo, Iowa

VAN GUILDER DOUBLE WALL
CONCRETE BUILDINGS

NOT FIRE-WOOD **BUT FIREPROOF**

Van Guilder reinforced double monolithic concrete walls are twice as strong as brick walls of the same thickness.

Concrete is the logical world product for general construction, but for housing men or animals, the walls must be double to be right—no solid places or cores to carry dampness and cold through.

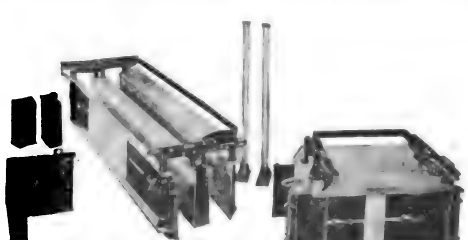
There must be two distinct monolithic walls entirely separated having a blanket of dead air between them. Dead air makes the best insulation in the world and costs nothing.

Unequalled for homes—No Dampness, even Temperature

Artistic up-to-date Mansion, Substantial, Permanent, Sanitary, Fire-proof.

Finest Equipped Dairy Plant in the World.

Fire-proof High School Building, Double Concrete Walls Cost $2,000 less than Brick.



The Machines

VAN GUILDER MACHINES

Van Guilder machines construct double wall concrete buildings—a house within a house like a THERMOS BOTTLE. Dampness, cold, and heat are effectually kept out.

The double walls are securely bound together by wall ties and are thoroughly reinforced. The strongest construction possible.

NO LATHING OR FURRING IS NECESSARY, which makes them perfectly sanitary and fireproof.

ENORMOUS FIRE LOSS

The loss by fire in this country is greater than in all the rest of the world. People are groping in the dark for a fire-safe construction that they can afford to use.

THE VAN GUILDER CONSTRUCTION is the solution of this terrible fire problem. The walls are much cheaper than any other masonry construction and compete with wood yet are age-proof in strength and durability.

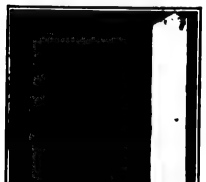
THEY SAVE HUNDREDS OF DOLLARS FORM EXPENSE

TWO SETS OF VAN GUILDER MACHINES that can be carried on a wheelbarrow did all the wall and partition work on the big high school building shown in cut.

THE MACHINES ARE SIMPLE AND ADJUSTABLE TO EVERY BUILDING DESIGN, making any kind of wall or angle. Cut building time in half. Save half the labor.

The Van Guilder system is the best and most economical concrete construction in existence.

What are you going to build? Let our Service Department show you how well it will pay you to build the Van Guilder way. Write us today.



Double Wall.

VAN GUILDER DOUBLE WALL COMPANY, Inc.

19 Engineering Building **ROCHESTER, N. Y.**

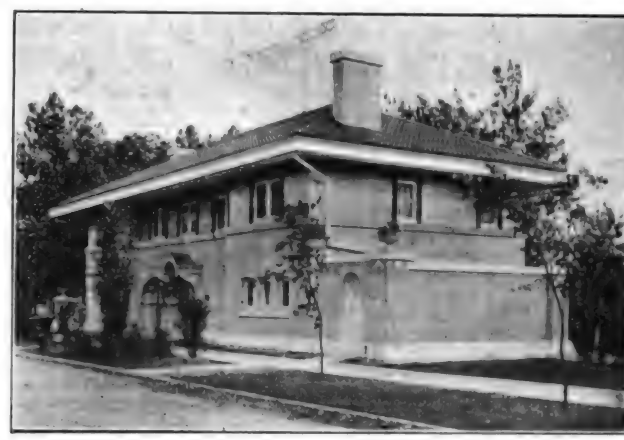
Ideal Shapely, Beautiful Blocks

Always Accurate and True

Chalmers Motor Car Co., Detroit, Mich.

In considering any building proposition do not overlook the many advantages presented by Ideal Block Machines.

They produce thoroughly cured, correctly made concrete blocks, so that the units shall be accurate in dimensions and artistic in design—as well as fireproof and waterproof. Ideal Concrete Blocks may be (and are) used successfully and economically *in any type of building.*



Dr. Harter Residence—Elkhart, Ind.

We show herewith reproductions of some of the styles of blocks we make, as well as illustrations of buildings constructed with Ideal blocks.

While the cuts indicate in a measure the appearance of the finished product, they do not and cannot reflect the high standards of manufacture maintained in our plant, nor the irreproachable quality which characterizes every item we produce. Our machines, being strong, durable and high-grade in every way, have a reputation for consistent results which we guard carefully. Every block is correctly-made, clean-cut and attractive.

Made any style of face, any standard or fractional size.

THE IDEAL CONCRETE MACHINERY CO.

COLERAIN AVE. CINCINNATI, OHIO

The U. S. Champion Concrete Tile

This cut shows our French Tile as they over-lap and interlock on both their sides and ends.

This cut shows how our French Tile looks when laid on roof.

A fireproof roofing that clinches the protection of a well built home—a roof of artistic beauty that harmonize with the architecture and adds security and value to the house it covers.

Use of The U. S. Champion Concrete Tile means a real economy. They are easily made and applied. They interlock and overlap one another on both sides and ends and make a rigid roof—absolutely waterproof and stormproof, in any color desired. In cost they compete successfully with any roofing, even wood shingles.

The U. S. Champion tile machinery consists of two different machines made and operated on the same principle—one for making tile of the French design and the other for making S-shaped Spanish tile. Among other important patented improvements on our machines is a device for making automatically an interlock on top of the upper end of the tile—an immense factor as a water- and wind-stop—CHARACTERISTIC FOR OUR ROOFING TILES ONLY.

Write for our description and prices.

This cut shows how our Spanish Tile looks when laid on roof.

L. HANSEN CO.

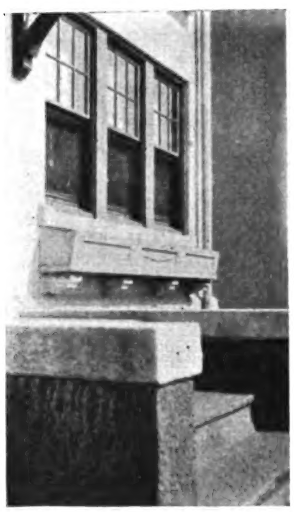
3617 E. 23RD STREET

KANSAS CITY, - - MO.

This cut shows how our Spanish Tile looks in detail.

The INGERSOLL Monolithic House

A fireproof everlasting concrete house at the price of wood



Description

A wood form that is set up to completely cast the exterior walls, partitions, floors and roof, in one operation, of five and one-half days.

Standardization

Provision is made in the form for window and door frames, concrete reinforcing, electric conduits, soil and vent roughing for the plumbing, the grounds for floor sleepers, wall furring and trim.

A Die-Casting Operation vs the Two-Foot Rule

The Ingersoll Monolithic House starts with a form that die casts the shell in one operation. The completion of this building is a series of predetermined operations, making it unnecessary to lay out each division in every house with a two-foot rule. All labor effort is confined to the completion of the standardized operation.

Ingersoll Houses may be seen at

Unionville, Union Co., H. I.

Phillipsburg, N. J., Ingersoll-Rand Co.

Cedar Hollow, Pa., Chas. Warner Co.

Type of House

Any layout or plan can be reproduced in concrete with this system at the same costs of a frame wood building.

In soliciting business for operations of fifty houses or more, I give you my assurance of a full and expert co-operation of my engineering service.

CHAS. H. INGERSOLL
OF
ROBT. H. INGERSOLL & BRO.

315 Fourth Avenue - - - NEW YORK CITY, N. Y.